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A STUDY TO DETERMINE THE ECONOMIC IMPACT OF NOISE
EMISSION STANDARDS IN THE CONSTRUCTION EQUIPMENT
INDUSTRY. PORTABLE AIR COMPRESSOR REPORT

A. T. Kearney, Incorporated

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OFFICE OF NOISE ABATEMENT AND CONTROL

A STUDY TO DETERMINE THE ECONOMIC IMPACT
OF NOISE EMISSION STANDARDS IN THE
CONSTRUCTION EQUIPMENT INDUSTRY

PORTABLE AIR COMPRESSOR REPORT

CONTRACT NO. 68-01-1542

JUNE, 1974

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Kearney Management Consultants

FORWARD

The Environmental Protection Agency, Office of Noise Abatement and Control, is publishing a series of reports prepared by contractors describing the technology, cost, and economic impact of controlling the noise emissions from commercial products. It is intended that these reports will provide information that will be useful to organizations or groups interested in developing or implementing noise regulations. This report was prepared by A. T. Kearney, Inc. under EPA Contract 68-01-1542.

ENVIRONMENTAL PROTECTION AGENCY
A STUDY TO DETERMINE THE ECONOMIC IMPACT
OF NOISE EMISSION STANDARDS IN THE
CONSTRUCTION EQUIPMENT INDUSTRY
PORTABLE AIR COMPRESSOR REPORT

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PORTABLE AIR COMPRESSOR REPORT

EXECUTIVE SUMMARY

At the request of the Environmental Protection Agency (EPA), A. T. Kearney, Inc. has conducted a study of the economic impact of alternative noise emission standards applied to portable air compressors. This Executive Summary provides an overview of the study results. The details of the study and supporting analysis and data will be found in the body of the report and supporting appendices.

The study report is organized into five sections:

- I - Introduction
- II - Technical and Cost Data Base
- III - Industry Characteristics
- IV - Baseline Industry Forecast
- V - Economic Impact.

The analysis in these sections is supported by more detailed data and analysis contained in 13 supporting appendices.

SECTION I -
INTRODUCTION

The scope of this study includes an analysis of the volume

changes, resource costs, industry and market impacts, foreign trade impacts, individual company impacts and potential economic disruption associated with the adoption of noise standards. The study considers only portable air compressors with air flow capacities above 75 cfm.

Kearney's primary source of information and data was manufacturers, distributors and users of portable air compressors, government agencies and industry associations. The technical and cost data base utilized was provided by EPA through a technical study conducted by Bolt Beranek and Newman Inc. (BBN).

SECTION II - TECHNICAL AND COST DATA BASE

The technical data provided for this study indicate that the difference between current standard and quiet portable air compressor models ranges from 6.7 dBA for gasoline models to 14.1 dBA for large diesel models.

Three alternate noise emission levels, each of which could be attained by "on-the-shelf" technology, were suggested for study. The technical study recommended that noise emission standards be set by engine type and air flow capacity as shown in the table on the following page.

<u>Level Limit</u>	<u>Sound Level Limits Suggested for Study(1)(2)</u>		
	<u>Gasoline Driven, Below 251 cfm (All)</u>	<u>Diesel Driven, Below 501 cfm</u>	<u>Diesel Driven, Above 500 cfm</u>
Level One	76 dBA	76 dBA	78 dBA
Level Two	73 dBA	70 dBA	73 dBA
Level Three	65 dBA	65 dBA	65 dBA

Notes: (1) Levels constitute a "not to exceed" criteria.

(2) Average sound pressure level in dBA at 7m according to the recommended measurement practice of ISO 2151-1972 modified to include an overhead measurement.

Relative to the current mean noise levels reported for standard models, the three levels represent an average reduction of 8.4 dBA for Level One, 12.2 dBA for Level Two, and 19.7 dBA for Level Three. In addition, the manufacturing tolerance required to meet a "not to exceed" standard is estimated as 2 dBA.

The Level One standard including the manufacturing tolerance is currently met by three standard and 14 quieted models. No models currently meet the Level Two or Level Three standards including the manufacturing tolerance.

The estimated cost of quieting these machines, based on an analysis of list price differentials, is shown in the table on the following page. Analyses made of accounting data and engineering estimates developed indicated that these costs which are used for the impact analysis are conservative.

Estimated Cost of Quieting Based
on Analysis of List Price Differentials

<u>Capacity/Engine Category</u>	<u>Current Mean to Level One</u>		<u>Level One to Level Two All Models</u> (\$/cfm)	<u>Level Two to Level Three All Models</u> (\$/cfm)
	<u>Standard</u> (\$/cfm)	<u>Model Type Quiet</u> (\$/cfm)		
Gasoline Engine, Below 251 cfm (All)	\$6.11	\$2.45	\$ 6.43	\$25.56
Diesel Engine, Below 501 cfm	8.40	3.19	13.19	23.60
Diesel Engine, Above 500 cfm	6.22	1.42	2.68	5.28

Source: Appendix A.

Lead times for major new model development cycles were estimated by manufacturers to be one to two years. Lead time periods enabling manufacturers to adopt noise suppression technology in an orderly manner for each noise level were also recommended by BBN. Time periods for enforcement used in the study are January 1, 1976 for Level One and January 1, 1978 for Level Two. Due to the fact that there is no current or prototype production model which meets a Level Three noise standard, and the only available cost data are based on an extrapolation, the economic impact for this noise level was not detailed.

Manufacturers have commented on the technical and cost data base and impact analysis; and they have expressed their concern over its validity and applicability in some instances.

SECTION III - INDUSTRY CHARACTERISTICS

The portable air compressor industry is a mature and highly competitive industry. Sales in 1972 amounted to about \$90 million. Over 12,000 units were shipped.

Portable air compressors are designed to power pneumatic tools at a job site or other end use application. The units are made from raw materials and components obtained from interdivisional transfers and other suppliers. They are distributed through construction equipment distributors or dealers who sell or lease the product to the end user. The primary end users are construction contractors, the mining industry, industrial users and government agencies. The basis to gauge productive capacity and performance of the units is the engine type (diesel or gasoline) and air flow rating in cubic feet per minute (cfm) at 100 pounds per square inch (psi).

Products competitive to portable air compressors are stationary air compressors, power take-off air compressors, and electric and hydraulic systems. Substitutability depends on capability in specific applications and cost differentials.

The single largest end use market for portable air compressors is the construction industry which currently accounts for an estimated 70% of total units shipped. Government agencies account for about 15% of the units, followed by mining and industrial users sharing another 15% of total shipments.

Channels of distribution traditionally are through independent authorized distributors and factory-owned distributors or branches. In excess of 50% of manufacturers' shipments of new portable compressors reach the end user via rental or rental/purchase agreements. Intermittent usage requirements result in a large rental market. The trend to increased rental of compressors is expected to continue. Used equipment is also an important factor in this portable air compressor market.

Expected life for portable air compressors is estimated to be 8 to 10 years for smaller units and 10 to 15 years for large capacity units.

There are 17 manufacturers selling in the domestic market. Two manufacturers had 1972 portable air compressor sales in excess of \$18 million and seven had in excess of \$2 to \$4 million.

In terms of product line, 13 compete in nearly all market segments (engine type and air flow capacity); four have a limited line only in the lower capacity segments. The manufacturing facilities (typically one plant per manufacturer) are concentrated in the Northeast and North Central United States.

From 6% to 13% of total annual shipments are exported each year; imports have been a minor factor in the market (less than 7% of 1972 unit volume).

SECTION IV - BASELINE INDUSTRY FORECAST

A baseline industry forecast was developed for the impact period 1976 to 1978 during which noise standards are expected to be initially enforced.

Impact Period Baseline Forecast of Total Sales of Portable Air Compressors

<u>Year</u>	<u>Forecast Unit Sales</u>
1972 (Actual)	12,154
1976	13,400
1977	13,700
1978	14,000

About 20% of this volume is forecast to be "quiet" models during the period. Assumptions and forecasts of basic market conditions were developed in support of the baseline forecast for industry.

It is estimated that the current population of air compressor units in use is about 100,000. This would be expected to increase to about \$140,000 in 1990 under an extrapolation of the baseline forecast conditions.

SECTION V - ECONOMIC IMPACT

Generally, the amount of impact on the portable air compressor market increases directly with the level of quieting achieved and the increasing costs required to attain it.

The development of the economic impact assessment is divided into six segments:

1. Volume Impact. This segment considers the question: What will be the changes in industry unit volume relative to the baseline forecast due to the increased costs from quieting? The change in unit volume is critical to the assessment of the complete economic impact scenario. It is the key to potential disruptive impacts.

Equipment prices are expected to increase as shown below:

<u>Power Source Type and Air Flow Capacity (cfm)</u>	<u>Summary of Estimated List Price Increases</u>	
	<u>Level One</u>	<u>Level Two</u>
Gasoline Engine, Below 251 cfm (All)	16.2%	33.2%
Diesel Engine, Below 501 cfm	18.4	47.2
Diesel Engine, Above 500 cfm	14.4	20.5
Average Price Increase	16.3%	33.6%

These price increases are anticipated to be passed on to end users.

Estimates of unit volume reductions are indicated on the following page.

Summary of Estimated First Year Unit
Reduction from Baseline Forecast

Power Source Type and Air Flow Capacity (cfm)	Unit Reduction	
	<u>Level One (1976)</u>	<u>Level Two (1978)</u>
Gasoline Engine, Below 251 cfm (All)	358	2,100
Diesel Engine, Below 501 cfm	148	1,154
Diesel Engine, Above 500 cfm	<u>101</u>	<u>244</u>
Total	<u>607</u>	<u>3,498</u>

Level One will result in an overall 4.5% decline in unit volume. Level Two will result in an overall 25.0% decline in unit volume.

2. Resource Costs. This segment addresses the question: What will be the cost of society's resources used to achieve the noise abatement program for portable air compressors? It reflects estimation of both the increased cost to purchase the noise abated units and the costs associated with the performance and maintenance changes caused by the application of quieting technology.

The resource cost estimates of noise abatement are as shown on the following page.

Summary of the Resource Costs
Associated with Noise Abatement
(Millions of Dollars)

<u>Noise Standard</u>	<u>First Year of Enforcement</u>		<u>1990 100% Quieted Population</u>
	<u>Capital Costs</u>	<u>Annual Costs</u>	
<u>Level One-1976</u>			
Lower Bound Estimates	\$18.1	\$3.6	\$31.5
Upper Bound Estimates	19.1	3.8	33.3
<u>Level Two-1978</u>			
Lower Bound Estimates	29.3	6.1	51.2
Upper Bound Estimates	39.1	8.1	68.2

The cost of noise attenuation appears high in relation to the total 1972 dollar volume of the portable air compressor market of approximately \$90 million.

3. Market Impacts. This area considers the question: What broad changes in industry and market conditions will be caused by the adoption of the proposed noise emission standards?

It is estimated that there will be little effect on upstream component suppliers. Distributors and end users could be affected in that alternative air sources and competitive systems will become a more important factor in working on or moving material.

There will be a significant effect on factory operations at Level One. Level Two might require more floor space and assembly time, and possibly some production line changes.

No unemployment is expected to occur due to Level One. Moderate unemployment in isolated localities may occur if Level Two is adopted.

4. Foreign Trade. This segment addresses the question: What impact, if any, will there be on exports, imports and the balance of trade?

It is anticipated that no changes in export patterns will occur because of noise regulations. Import patterns are not expected to change due to Level One. Imports may significantly penetrate the domestic market with a Level Two noise standard if adequate lead times are not established and domestic manufacturers cannot produce a unit which is price-competitive with imported units.

5. Individual Impacts. This area considers the question: What impacts are expected to fall differentially on specific companies or industry segments? Will these companies or plants be seriously injured?

It is anticipated that no manufacturers will withdraw from the portable air compressor market at Level One. If Level Two is adopted, some small manufacturers with weak financial positions are likely to withdraw from the market.

6. Disruptive Impacts. This segment addresses the question: What real world economic disruption can be expected to occur from the adoption of the noise standard? It draws the distinction between changes which may occur in an orderly way

within the range of adjustments which can be expected and accommodated in a free market system and changes which may cause unemployment, shutdown of plants, and other real world disruptive effects because the adjustments are large and/or the time for adjustment short in relation to today's market conditions and industry capabilities.

No disruptive impacts are indicated at Level One. The potential for disruptive changes to the industry exists with a Level Two standard, particularly with a short lead time which would provide an opportunity for import competition to penetrate the domestic market. In any event, no significant disruption is estimated to be transmitted to the national economy or regional economies.

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I - INTRODUCTION

INTRODUCTION

Section 6 of the Noise Control Act of 1972 provides that the Administrator of the Environmental Protection Agency (EPA) shall establish noise emission standards (where feasible) on products which are found to be major sources of noise or are in specific product categories named in the law. This regulatory program is applicable to construction equipment products in both instances.

Section 6 further states that the regulation:

Shall include a noise emission standard which shall set limits on noise emissions from such product and shall be a standard which...is requisite to protect the public health and welfare, taking into account the magnitude and conditions of use of such product...the degree of noise reduction achievable through the application of the best available technology, and the cost of compliance... Any such noise emission standards shall be a performance standard. In addition, any regulation... may contain testing procedures necessary to assure compliance with the emission standard in such regulation, and may contain provisions respecting instructions of the manufacturer for the maintenance, use, or repair of the product.

In support of the staff studies being conducted to comply with the requirements of the Noise Control Act, EPA requested A. T. Kearney, Inc. to conduct a study of the economic impact associated with the adoption of alternate levels of noise emission standards for selected construction equipment products.

This report addresses the economic impact on portable air compressors.

(a) Product
Definition

For the purposes of this study, portable air compressors are defined as stated in the paragraph below:

Portable air compressors activate pneumatic tools and equipment at the construction site. The prime function of equipment is based on the principle of the displacement of air to work on or move material in the construction process. A portable air compressor consists of an air compressor (air end) and a gasoline or diesel internal combustion engine rigidly connected in permanent alignment and mounted on a common frame. The compressor is provided with complete cooling, lubricating, regulating, starting and fuel system and all equipment necessary to constitute a complete, self-contained unit. Portable air compressors included are wheel mounted but not self propelled. Units included are those which develop 75 and over cfm at 100 psi. Excluded are the pneumatic tools and equipment themselves.

(b) Scope of Study

The basic objective of the study was to assess the economic impact of the adoption of alternate noise emission standards on the portable air compressor industry. This assessment included consideration of the impact on raw material and component suppliers, manufacturers, distributors, end users and the general public. The industrywide impact and the distribution of impacts on market segments and individual companies were determined. The impact on key governmental policy concerns such as employment and the balance of trade was also assessed.

The scope of Kearney's impact study was further defined as follows:

1. Only "costs" to society were included in the study. Assessment of the health and welfare benefits of the cost/benefit relationships associated with noise abatement were not included.
2. The quieting technology and the manufacturing cost per portable air compressor for noise abatement were provided to EPA by its technical contractor. Evaluation of the validity and reliability of this technology and the costs were not in the scope of this study.
3. The study was concerned with an assessment during an impact period when the regulation would most likely become effective (1976, 1977 and 1978). Impact considerations and long-run economic effects beyond this time frame were not in the scope of the study. For example, the development and substitution of new technology is excluded from the study.
4. The cumulative impact of other environmental, safety and health, energy and economic regulatory programs of the federal, state and local governments was not included in the scope of the study. The impact study dealt with the noise standards in a manner incremental to these other factors which were broadly considered in a baseline forecast.

ECONOMIC IMPACT

Kearney segregated the analysis of economic impact into six segments.

1. Volume Impact. This segment includes the analysis of changes in industry volume which will occur relative to a baseline forecast.
2. Resource Costs. This segment includes the cost of the resources used to achieve noise abatement and reflects the increased costs to purchase the noise abated equipment and the cost associated with any performance and maintenance changes.
3. Market Impacts. This segment includes an analysis of broad changes in industry and market conditions that might be attendant on the adoption of the proposed noise emission standards.
4. Foreign Trade. This segment covers an assessment of the impact on exports, imports and the balance of trade.
5. Individual Impacts. This segment considers assessment of market impacts which fall differentially on specific companies or industry segments. The impact "shakedown" might include economic dislocations, unemployment, lowered sales volume and profits, and change in market shares.
6. Disruptive Impacts. These impacts are analyzed in the context of real world economic disruption. If industry growth is slowed, employment is reduced over what it would have been had there not been any noise emission standards. If this effect is adequately foreseen as a future consequence of the noise regulations, and planned for by the industry, disruptive effects such as plant shutdowns and unemployment are unlikely. Thus, there is a clear distinction between potential impacts such as the loss in future employment and disruptive real world impacts.

METHODOLOGY

The technical and cost data base for the impact study was provided to Kearney by EPA through a study conducted by Bolt Beranek and Newman Inc. (BBN). It is documented in their report, "Portable Air Compressors: The Costs, Benefits, and Penalties of Reducing Their Noise."

Kearney's primary source of information and data was directly from manufacturers, distributors and users of portable air compressors, government agencies, and industry associations. Exhibit I-1* lists those contacted during the course of the study. Kearney gratefully acknowledges the often extensive cooperation provided by these firms. Published data and other secondary sources of information were also utilized.

Kearney used two approaches to assessing economic impact-- obtaining direct estimates based on field interviews and published information and making indirect estimates by analyzing the impacts in a supply/demand model based on economic theory. The actual measurement of impact was made by projecting market conditions for 1976-1978 both with and without noise emission standards. Specific impacts were considered in isolation and then the interrelationships were developed.

Further details of Kearney's approach to the study are documented in a separate "Methodology Report" submitted to EPA.

* All exhibits appear at the end of the section in which they are referenced.

THE ENVIRONMENTAL PROTECTION AGENCY
PORTABLE AIR COMPRESSOR STUDY CONTACTS

<u>Portable Air Compressor Manufacturers</u>	<u>Location</u>
American Jenbach	Burlington, North Carolina
Atlas Copco	Hackensack, New Jersey
Bristol	Middleton, New York
Chicago Pneumatic	Franklin, Pennsylvania
Davey Compressor	Kent, Ohio
Gardner-Denver	Quincy, Illinois
General Supply and Leasing	Kansas City, Missouri
Grimmer-Schmidt	Franklin, Indiana
Holman	Clarkston, Ontario
Ingersoll-Rand	Mocksville, North Carolina
Jaeger	Columbus, Ohio
Joy Manufacturing Company	Michigan City, Indiana
Kent Air Tool	Kent, Ohio
Le Roi	Sidney, Ohio
Lindsay	Deerfield, New Hampshire
Quincy Compressor	Quincy, Illinois
Schramm	West Chester, Pennsylvania
Gordon Smith	Bowling Green, Kentucky
Sullair	New York, New York
Worthington	Holyoke, Massachusetts

<u>Construction Equipment Distributors</u>	
Akron Contractors Equipment	Ohio
Andrews and Andrews	Oregon
Angerstein Industries	Delaware
Arizona Cedar Rapids	Arizona
Arrowhead Machinery	Idaho
Bartholow, J.R.	Texas
Bell Air Compressor	Washington, D.C.
Brooks, Ray, Machinery	Alabama
Clark, W.I.	Connecticut
Clark-Wilcox	Massachusetts
Cobusco	Colorado
Corn Husker Tractor	Nebraska
Deaney, A.F.	Indiana
Dinzler, H.M.	Missouri
Florida Equipment of Jacksonville	Florida
Gregory, J.J.	Rhode Island
Hall Supply	Mississippi
Harrison Equipment	New Jersey

Construction Equipment
Distributors, cont.

Location

Heck Equipment	Kentucky
Higgins Industrial	Minnesota
King Tractor	New York
McAllister Equipment	Illinois
Mitchell Machinery	Arkansas
Morgan Equipment	California
Palmer Equipment	Michigan
Schaefer Equipment	Virginia
Smith, L.B.	Maryland
Southern States Equipment	Louisiana
Stapham Machinery	Georgia
Walker, Eddy, Equipment	Iowa

Trade Associations

American Road Builders Association	Washington, D.C.
Associated Equipment Distributors	Chicago, Illinois
Associated General Contractors of America	Washington, D.C.
Construction Equipment Manufacturers Association	Milwaukee, Wisconsin
National Asphalt Pavement Association	Riverdale, Maryland
The Compressed Air and Gas Institute	Cleveland, Ohio and Washington, D.C.
The Engine Manufacturers Association	Chicago, Illinois

Construction Contractors

Albecht, E.J.	Chicago, Illinois
Kaiser Engineers	Oakland, California
Material Service Company	Chicago, Illinois
S&M Construction Company	Washington, D.C.
Utah Construction	Oakland, California

Tool Manufacturers

Black and Decker Corporation	Baltimore, Maryland
Racine Federated Inc.	Racine, Wisconsin
Skil Corporation	Chicago, Illinois
Thor Power Tools	Aurora, Illinois

<u>Other</u>	<u>Location</u>
Construction Equipment Division, Mobility Research and Development Command, United States Army	Fort Belvoir, Virginia
University of Denver College of Engineering	Denver, Colorado
Informatics, Inc.	Washington, D.C.
United States Department of Commerce	Washington, D.C.
United States Department of Interior	Washington, D.C.

II - TECHNICAL AND COST DATA BASE

Bolt Beranek and Newman Inc. (BBN) was retained by EPA to provide technical and cost data on the potential for noise abatement for portable air compressors. BBN determined present noise emission levels of portable air compressors, recommended a noise emission test, suggested alternate noise emission standards for study, described a product modification strategy to attain these sound levels and reviewed the technical characteristics of potential import compressors. BBN estimated the costs of achieving alternate levels of noise abatement through analysis of list price differentials for standard and quiet units and engineering estimates for selected specific units. They also estimated the lead times required for an orderly adoption of the noise abating modifications. These study results are documented in BBN's report entitled, "Portable Air Compressors: The Costs, Benefits, and Penalties of Reducing Their Noise." Kearney was provided the BBN data by EPA as the data base on which to assess economic impact.

In addition to the BBN cost analysis, Kearney obtained data on standard and quiet compressor cost differentials directly from manufacturers through the cooperation of the Compressed Air and Gas Institute (CAGI).

The remainder of this section describes the technical and cost data base provided for assessment of economic impact, under the following headings:

- . Noise Levels of Current Compressors
- . Noise Emission Levels Suggested for Study

- . Cost Estimates for Noise Abatement
- . Cost Estimates Used for Impact Study
- . Lead Times
- . Assessment Data Base
- . Industry Views.

NOISE LEVELS OF
CURRENT COMPRESSORS

BBN obtained data from manufacturers on the noise levels of their current models of portable air compressors. A summary of this data is presented in Exhibit II-1. The mean and standard deviation of noise levels of current models in the three major categories of capacity and engine type utilized in the BBN analysis is shown in the table below:

Table II-1

Current Portable Air Compressor Model
Noise Levels by Engine Type and Capacity

<u>Category</u>	<u>Standard Models</u>		<u>Quiet Models</u>	
	<u>Mean</u> (dBA)	<u>Standard</u> <u>Deviation</u> (dBA)	<u>Mean</u> (dBA)	<u>Standard</u> <u>Deviation</u> (dBA)
Gasoline Engine, Below 251 cfm (All)	82.8	4.92	76.1	2.40
Diesel Engine, Below 501 cfm	86.1	3.35	76.4	4.07
Diesel Engine, Above 500 cfm	92.8	4.08	78.7	3.90

Source: Exhibit II-1 and manufacturer data.

The preceding data are based on 194 observations. Kearney estimates this represents 55% to 65% of the total models offered.

The means are simple averages. The information required to weight the noise levels by relative model sales is not available. Weighting by estimates of capacity and/or manufacturer market share was not utilized.

Note that the data in the table indicate that the difference between current standard and quiet models ranges from 6.7 dBA for gasoline models to 14.1 dBA for large diesel models.

BBN has also tested a number of portable air compressors. Relative to the manufacturer-submitted data summarized in Table II-1, the BBN tests results indicated:

1. There was a significant deviation from manufacturer data for individual models. The BBN test data ranged ± 3 dBA from the manufacturer's results. However, the mean of the two samples was the same.

2. There was a 1.7 dBA range when four units of the same model were tested. The mean of the BBN tests was the same as the noise level reported by the manufacturer.

NOISE EMISSION LEVELS SUGGESTED FOR STUDY

Based on their technical study, BBN suggested three alternate portable air compressor noise emission levels for impact study. Each of these three levels can be attained by "on-the-shelf" technology. The technical characterization of each level is as follows:

1. Level One corresponds to the average quieted portable air compressor model currently on the market.

2. Level Two corresponds to the lowest decile of the quietest portable air compressor model currently on the market.

3. Level Three corresponds to the best demonstrated portable air compressor noise emission reduction technology.

As a result of their study, BBN recommended that noise emission standards be set by portable air compressor engine type and cfm capacity. The categories suggested are gasoline engine, below 251 cfm (All); diesel engine, below 501 cfm; and diesel engine, above 500 cfm.

Table II-2 cites the noise emission levels recommended by BBN for study.

Table II-2

Sound Level Limits Suggested
for Study(1)(2)

<u>Level Limit</u>	<u>Gasoline Driven, Below 251 cfm (All)</u>	<u>Diesel Driven, Below 501 cfm</u>	<u>Diesel Driven, Above 500 cfm</u>
Level One	76 dBA	76 dBA	78 dBA
Level Two	73 dBA	70 dBA	73 dBA
Level Three	65 dBA	65 dBA	65 dBA

Notes: (1) Levels constitute a "not to exceed" criteria.

(2) Average sound pressure level in dBA at 7m according to the recommended measurement practice of ISO 2151-1972 modified to include an overhead measurement.

Source: Bolt Beranek and Newman Inc.

Relative to the current mean noise levels reported for standard models, the three levels suggested for study represent a

weighted⁽¹⁾ average reduction of 8.4 dBA for Level One, 12.2 dBA for Level Two, and 19.7 dBA for Level Three.

Consideration must be provided for the manufacturing tolerance that is required to meet a "not to exceed" standard. BBN's data indicate that a 2 dBA tolerance appears to be a reasonable estimate of this requirement. On this basis, to meet a 76 dBA level, the model would have to be quieted to an average of 74 dBA $\pm$ 2 dBA manufacturing tolerance.

From analyzing the requirements to meet the suggested levels, it can be concluded that:

1. For the gasoline engine models for which noise data were reported:

- (a) Three standard models (9.4%) and four quieted models (15.4%) currently meet a Level One standard.
- (b) No average models currently meet the Level Two or Level Three standards including the 2 dBA tolerance.

2. For the diesel engine, below 501 cfm models for which noise data were reported:

- (a) No standard models and six quieted models (17.1%) meet the Level One standard.
- (b) No models meet Level Two or Level Three standards including the 2 dBA tolerance.

(1) Weighted on the basis of estimated 1972 unit sales of standard models for domestic consumption. See Table III-9.

3. For the diesel engine models, over 501 cfm for which noise level data were reported:

- (a) No standard models and four quieted models (16.7%) meet the requirements of a Level One standard.
- (b) No models meet the requirements of the Level Two or Level Three standards including the 2 dBA tolerance.

COST ESTIMATES FOR NOISE ABATEMENT

The major source of cost data developed for impact study is an extensive analysis conducted by BBN of list price differentials between standard and quieted models. These prices reflect current market list prices to the end user for quieting and are assumed to reflect in a normal competitive manner an appropriate average marginal cost of quieting at the list price level. In addition, BBN estimated direct labor and material costs for quieting specific models based on their own technical experimentation and analysis. Also, Kearney obtained accounting data from a number of manufacturers through the cooperation of CAGI (see Appendix A, Exhibit A-2). In addition, separate consideration has been given to the range of costs for manufacturers which may be associated with alternate compliance and enforcement procedures.

Detailed summaries of the cost and technical information developed in these studies is provided in:

1. Appendix A - CAGI Cost Estimate Survey Results
2. Appendix B - BBN Engineering Cost Estimates
3. Appendix C - Costs of Assuring Compliance.

The following paragraphs briefly review the key results of the technical and cost studies. For an understanding of the qualifications, assumptions, methods, rationale and details behind the data presented, it is necessary to refer to the appendices.

(a) BBN Price Analysis

The BBN study estimating the cost of quieting through analysis of list price differentials resulted in the cost estimates by level summarized in the table below:

Table II-3

Estimated Cost of Quieting Based
on Analysis of List Price Differentials

<u>Capacity/Engine Category</u>	<u>Current Mean to Level One</u>		<u>Level One</u>	<u>Level Two</u>
	<u>Model Type</u>		<u>To Level Two</u>	<u>to Level Three</u>
	<u>Standard</u>	<u>Quiet</u>	<u>All Models</u>	<u>All Models</u>
	<u>(\$/cfm)</u>	<u>(\$/cfm)</u>	<u>(\$/cfm)</u>	<u>(\$/cfm)</u>
Gasoline Engine, Below 251 cfm (All)	\$6.11	\$2.45	\$ 6.43	\$25.56
Diesel Engine, Below 501 cfm	8.40	3.19	13.19	23.60
Diesel Engine, Above 500 cfm	6.22	1.42	2.68	5.28

Source: Exhibit II-2.

These costs reflect quieting the average models to each level on a "not to exceed" basis incorporating a 2 dBA manufacturing tolerance based on the dBA reduction required from the mean

noise levels as reported in Exhibit II-1. The cumulative cost of reaching Level Three is the sum of the costs to reach each level in sequence. From the data in the table it can be noted that:

1. The costs required to reach Levels Two and Three are significantly lower per cfm for the units above 500 cfm capacity. This indicates an increase in the economies of scale of larger machines.

2. The higher cost estimated for diesel units below 501 cfm to meet Level Two primarily reflects a 3 dBA greater reduction in the suggested standard than is applied to the gasoline engine category.

The BBN estimates can be characterized as costs associated with an orderly change with adequate lead time. The costs can be viewed as those which would typically be developed at the list price level for a significant engineering change order for the model concerned. The cost estimates do not include any provision for an extensive factory testing system, prototype certification, or other possibly significant compliance costs which may be imposed by regulation.

BBN estimates that there will be no performance degradation due to application of quieting technology at any level. However, minor operating cost increases are anticipated primarily in increased fuel consumption. Quantitative estimates are not provided.

BBN's analysis is based on application of current technology. From their technical study, application of current technology may not be an optimal strategy to achieve the desired levels. They suggest that Level Three costs based on current technology may be substantially higher than the actual cost of achieving Level Three through the use of new, developing technology.

(b) CAGI Cost Estimate
Survey Results

Kearney developed an estimate of list price increases through the cooperation of CAGI in surveying the industry. Quieting costs were developed from data furnished by a limited sample of manufacturers. A review of the cost data submitted was performed to verify the results. The extent of cooperation and data provided varied and definite data gaps were present.

Quieting costs estimates were developed on the basis of "full margin" costs and "incremental margin" costs.

1. Full Margin Costs. Kearney's "full margin" method is based on actual increases in direct material purchased and direct labor of fabrication and assembly as reflected in the accounting system. It allocates the "full margin" of other costs (overheads, profit, etc.) at the same rate to a quieted unit as is currently allocated to a standard unit. This method can be expected to overstate the actual cost change.

2. Incremental Margin Costs. Kearney's "incremental margin" cost reflects an adjustment to the "full margin" data.

Full margins include overhead accounts which will not change with the introduction of quieting or change less than the estimates based on application of "margin dollars" at the same percentage rate as on a standard machine. The "incremental margin" rate estimated by Kearney reflects inclusion of changed costs in overhead accounts and profit margins required to fully reflect all incremental costs and profits on increased investments (i.e., raw material inventories), as well as direct labor and material costs designed to leave the company in the same overall position as with current production. This method attempts to reflect the actual cost change incurred.

A detailed description of the methodology used and results obtained from CAGI cost data is presented in Appendix A. The result indicates that:

1. "Full margin" estimates are often above the BBN list price estimates, particularly without the 2 dBA tolerance considered.
2. "Incremental margin" estimates are below the BBN list price estimates for the smaller air flow capacities and about the same as the BBN estimates with tolerance for the larger air flow capacities.

(c) BBN Engineering
Cost Estimates

BBN developed an estimate of list price increases based on "job shop" quotations for three quieted portable air compressors which they examined technically in detail. This method is

based on the additional incremental direct material used on a quieted unit and the additional direct labor required to assemble a quieted unit. Estimates of the incremental margin and profit are then added to these direct costs and corresponding list prices are determined. Quieting costs were developed utilizing BBN incremental direct material and additional direct labor estimates on the basis of BBN assigned margin costs, Kearney "full margin" costs and Kearney "incremental margin" costs. A detailed description of the methodology used and results obtained from BBN engineering cost estimates is presented in Appendix B. The data from the three machines indicate costs below the list price analysis for the power source and air flow capacity categories in which the machines fall.

(d) Comparison of the List
Price Increases Obtained
by the Various Methods

A comparison of the list price increases associated with the BBN list price analyses, the CAGI cost survey estimate results, and the BBN engineering cost estimates is presented in Table II-4. These cost figures in all cases represent the cost per cfm of capacity based on new list prices resulting from making the modifications necessary to meet Level One noise emission requirements.

Table II-4
Comparison of Quieting List Price Increases
(Dollars per cfm of Capacity)

BBN Engineering Cost Estimates(1)	Kearney CAGI Standard Cost Evaluation(2)				BBN List Price Analyses(3)				
	Full Margin w/o		Incremental Margin w/		Price w/o (5)	Tolerance w/ (5)			
	Tolerance (5)		Tolerance (5)						
Gasoline Engine, Below 251 cfm (All)	\$4.64	\$3.73	\$2.83	\$4.10	\$4.78	\$2.75	\$3.10	\$4.15	\$6.11
Diesel Engine, Below 501 cfm	8.08	6.22	4.70	5.98	6.80	2.50	2.75	6.23	8.40
Diesel Engine, Above 500 cfm	3.69	2.98	2.26	9.08	9.42	6.40(4)	6.65(4)	5.38	6.22

Notes:

- (1) See Table B-5, Appendix B. Sample size 3 units.
- (2) See Table A-8, Appendix A. Sample size 19 units.
- (3) See Exhibit II-2. Sample size 194 units.
- (4) Includes costs for several machines which are thought to be able to meet a Level Two standard with very little additional cost based on the current noise abatement features engineered into the unit.
- (5) Tolerance is the 2 dBA tolerance between the Level One average and the "not to exceed" sound levels. The difference between the w/ and w/o tolerance data is the cost of the further 2 dBA reduction.

Sources: Exhibit II-2 and Tables A-8 and B-5.

Note that the list prices associated with meeting Level One requirements are higher using the BBN list price analysis with the 2 dBA tolerance for all cases except the diesel engine, above 500 cfm category under the Kearney CAGI standard cost evaluation. In this latter case, the costs are above the BBN engineering estimate and of the same order as Kearney's "incremental margin" estimates.

(e) Compliance and
Enforcement Costs

The cost estimates discussed above do not consider the costs which will arise due to the compliance and enforcement procedures required of portable air compressor manufacturers. Estimates of these costs under different assumptions are developed in Appendix C - Costs of Assuring Compliance.

COST ESTIMATES USED
FOR IMPACT STUDY

BBN engineering cost estimates for three portable air compressors and Kearney estimates for 19 units based on accounting data have been developed in addition to the BBN list price analysis of 194 models.

List price increases calculated using BBN engineering cost estimates in all cases are lower than those calculated using the BBN list price analysis. List price increases calculated using the BBN list price analysis were compared to those calculated using the Kearney CAGI cost evaluation at "full margin" and

"incremental margin" for the 19 different models studied. In approximately 65% of these cases, the BBN list price based estimates exceed those based on "full margin." In approximately 10% of the sample, "full margin" list price changes exceed those based on the list price analysis but the differences are not significant. Of the five remaining cases, where "full margin" changes exceed the list price based changes, four relate to units that the manufacturers believe would be able to comply with suggested Level Two sound characteristics, with minor modifications and therefore a low concomitant price change. The fifth unit does not yet meet suggested Level One criteria. On an "incremental margin" basis, the BBN list price estimates are higher for the low air flow capacity categories and about the same for the high capacity category.

The limited sample data and the methodology utilized in developing the estimates do not permit treating the BBN engineering and Kearney accounting cost estimates with a high degree of significance in relation to the more extensive sample based on the analysis of list prices. These qualifications are more fully developed in Appendices A and B. However, these additional estimates do provide a useful cross-check on the validity of the BBN list price analysis results.

On the basis of using the BBN list price analysis to estimate the cost of quieting portable air compressors, it can be concluded

that the economic impact analysis is a conservative estimate and thereby indicative of the upper limit on the expected economic impact. The BBN list price analysis is conservative based on the cross-checking cost analyses performed and the conservative assumptions made in incorporating the 2 dBA tolerance. Also, it does not include savings associated with economies of full production of quiet machines. On this basis, it was determined that it was not necessary to add the estimated costs of compliance to the quieting costs estimated by BBN list price analysis. The low level of compliance costs can be subsumed validly under the conservative estimate developed.

LEAD TIMES

BBN estimates lead times for development cycles involving major tooling to be approximately one to two years for portable air compressors. Based on the technical quieting strategy for each level, BBN recommended the following lead times to achieve the noise emission levels suggested for study.

1. Level One - six months.
2. Level Two - 18 months.
3. Level Three - three to five years.

ASSESSMENT DATA BASE

Kearney's economic impact assessment is based on the technical and cost data base provided by EPA through its contract with BBN. Insofar as this information is changed, modified or

inaccurate, the economic impact assessment will correspondingly require modification. In addition, Kearney's economic impact assessment is based on assumptions described below. These assumptions were made by Kearney in order to have a concrete basis on which to project economic impact.

1. Enforcement. The enforcement program applicable to the noise standards for portable air compressors has not been finalized by EPA. Several different approaches are possible. The economic impact study assumes the enforcement scenario and costs discussed above. Insofar as these costs change significantly, the economic impact assessment will have to be modified to consider them.

2. Time Periods. For purposes of simplification, the impact assessment has been estimated in terms of calendar years. The presentation developed in the text is based on the lead times developed by BBN corresponding to first year enforcement starting on:

- (a) Level One - January 1, 1976.
- (b) Level Two - January 1, 1978.
- (c) Level Three - No estimate.

Documentation has been provided so that assumptions on the year of adoption can be modified.

3. Compliance. It is assumed that compliance with the regulation will not require certification of noise emission characteristics other than as a new product. Certification programs requiring prototype testing or responsibility for noise levels

generated after being in operation would involve costs and other considerations not provided for in this assessment.

4. Retrofit. It is assumed that no air compressors built prior to the effective date of the noise standard will be required to adopt a noise abatement retrofit.

5. State Noise Laws and Local Ordinances. It is assumed that the pattern of developing noise regulation will remain about the same. No major new state or local regulations will be passed which will substantially change requirements prior to the EPA noise regulations taking effect.

6. Other Regulations. It is assumed that the pattern of current federal regulations will evolve in its present framework. No other new federal laws will be passed prior to the EPA noise regulations taking effect.

INDUSTRY VIEWS

It is not in the scope of Kearney's study to validate or adjust the technical and cost data provided by EPA through its contract with BBN as the basis for the assessment of economic impact. However, in the course of our study, manufacturers of portable air compressors provided information on their views of the data base being used for the study and on the developing noise regulation program. While not evaluating the validity of these views, Kearney believes that an understanding of industry viewpoints is background essential to its study. A summary of these views is presented in Appendix D - Industry Views. The following paragraphs

provide a brief review of the major points made.

(a) Proposed Sound
Level Limits

The reaction of most manufacturers to the proposed sound level limits can be generalized as:

1. Level One and Level Two are technically possible.
2. The present state of sound suppression technology has not advanced to the point where they can make a judgment on whether or not Level Three is technically possible. Nearly all manufacturers stated that Level Three would be highly impractical. Major design modifications would be necessary. In their judgment, these modifications would most likely result in equipment efficiency reductions, maintenance cost increases, operating cost increases and high overall costs to society.

(b) Cost Estimates

In accordance with the revised BBN study, industry reaction to the cost estimates to attain the proposed sound level limits was mixed, as indicated in the characterization below:

1. Level One. Manufacturers that presently have quieted units on the market generally agreed with the overall order of magnitude of the BBN cost estimates.
2. Level Two. Few manufacturers had experience in the production of portable air compressors which would meet Level Two noise emission requirements.

3. Level Three. Manufacturers had no estimates of the costs necessary to achieve Level Three. They basically did not agree that this level was technically feasible with current technology and therefore had no framework on which to base cost estimates.

Other manufacturers strongly disagreed with the BBN cost estimates and stated that noise reduction experience to date indicates that cost estimates in advance of actual development work are of doubtful value and usually "miss the mark."

(c) Lead Times

Industry reaction to the proposed lead times can be summarized as follows:

1. Level One. Manufacturers that presently have quieted units on the market generally agreed with the overall order of magnitude of the list price increases associated with the BBN list price analysis for gasoline engine and diesel engine, below 501 cfm units. However, they stated that the costs to quiet diesel engine, above 500 cfm units would be approximately 50% higher.

2. Industry representatives feel that it is extremely important that potential substitute products have similar if not identical noise emission standards imposed. The most important substitute products for portable air compressors are stationary compressors, hydraulic systems, high cycle electric systems and conventional electric systems.

3. Manufacturers pointed out that the engine is the major cause of noise. Portable air compressor manufacturers do not have the purchasing power to collectively force the engine manufacturers to make noise suppression modifications. Therefore, the feeling exists that engine manufacturers should also be regulated. Manufacturers believe this would be very helpful in solving the problems of industries which manufacture products using an engine as the power source.

4. Many manufacturers took exception to the categories proposed by BBN as not breaking at present competitive break points. The most frequently offered alternative was gasoline engine, 75-124 cfm and 125-250 cfm; and diesel engine, 75-124 cfm, 125-249 cfm, 250-599 cfm, 600-899 cfm and 900 cfm and over.

THE ENVIRONMENTAL PROTECTION AGENCY
PERCENT OF PORTABLE AIR COMPRESSORS
THAT SATISFY A GIVEN NOISE LEVEL

Major Category of Portable Air Compressors by Capacity

Gasoline Engine, Below 251 cfm (All)(2)						Diesel Engine, Below 501 cfm Capacity					
Standard Models			Quieted Models			Standard Models			Quieted Models		
dBa Level	Percent of Cumulative Units Below	Number of Units Below	dBa Level	Percent of Cumulative Units Below	Number of Units Below	dBa Level	Percent of Cumulative Units Below	Number of Units Below	dBa Level	Percent of Cumulative Units Below	Number of Units Below
71.0	0.0 %	0	72.0	0.0 %	0	79.5	0.0 %	0	70.0		
72.0	3.12	1	73.0	11.54	3	80.5	2.22	1	71.0		
73.0	3.12	1	74.0	15.38	4	81.5	2.22	1	72.0		
74.0	9.37	3	75.0	26.92	7	82.5	17.78	8	73.0		
75.0	9.37	3	76.0	50.00	13	83.5	24.44	11	74.0		
76.0	12.50	4	77.0	65.38	17	84.5	31.11	14	75.0		
77.0	12.50	4	78.0	69.23	18	85.5	48.89	22	76.0		
78.0	18.75	6	79.0	84.62	22	86.5	62.22	28	77.0		
79.0	18.75	6	80.0	92.31	24	87.5	71.11	32	78.0		
80.0	21.87	7	81.0	100.00	26	88.5	73.33	33	79.0		
81.0	28.12	9				89.5	77.78	35	80.0		
82.0	28.12	9				90.5	86.67	39	81.0		
83.0	34.37	11				91.5	88.89	40	82.0		
84.0	50.00	16				92.5	97.78	44	83.0		
85.0	62.50	20				93.5	100.00	45	84.0		
86.0	75.00	24							85.0		
87.0	81.25	26							86.0		
88.0	90.26	29							87.0		
89.0	90.62	29							88.0		
90.0	93.75	30									
91.0	96.87	31									
92.0	100.00	32									

Mean: 82.8 dBA(3)
Standard Deviation: 4.92 dBA

Mean: 76.1 dBA(3)
Standard Deviation: 2.40 dBA
Mean of Models:
74 dBA and Above: 76.8 dBA

Mean: 86.1 dBA(3)
Standard Deviation: 3.35 dBA

Mean:
Standard
Mean of
74 dBA and Above

- Notes: (1) Average sound pressure level in dBA at 7m according to the recommended measurement practice of ISO 2151-1972. Manufacturers were sometimes imprecise in defining the noise data submitted to BBN. BBN has treated these data as an average of noise level for a model based on testing a number of units. This is a conservative assumption since it is thought that some of the data for quiet models represent results for sales on a "not to exceed" basis for the model because it is the advertised noise levels used to meet noise ordinances. Therefore, it would incorporate manufacturing variances and further allowance of a tolerance would not be required.
- (2) BBN did not document in its report the manufacturers whose model data are included in the 194 data points reported. Due to confidentiality restrictions, Kearney was not provided a complete identification of the models in the noise data base. Kearney estimates that there are about 300 to 350 models currently marketed separately counting standard and quieted versions but excluding models without running gear or incorporating running gear or other minor modifications. This suggests that the noise data in the exhibit represent about 55% to 65% of all models marketed.
- (3) The mean is a simple average of model noise data. Data are not available to weight by relative model unit volume sold. Partial weighting schemes by capacity and/or manufacturer were not utilized.

Source: Bolt Beranek and Newman Inc.

A

THE ENVIRONMENTAL PROTECTION AGENCY

EXHIBIT II-1

PERCENT OF PORTABLE AIR COMPRESSORS
THAT SATISFY A GIVEN NOISE LEVEL(1)

Portable Air Compressors by Capacity and Type of Engine

Diesel Engine, Below 501 cfm Capacities(2)

Models	Number of Units Below	dBa Level	Percent of Cumulative Units Below	Number of Units Below
		70.0	0.0 %	0
		71.0	11.43	4
		72.0	11.43	4
		73.0	14.29	5
		74.0	17.14	6
		75.0	22.86	8
		76.0	57.14	20
		77.0	68.57	24
		78.0	71.43	25
		79.0	77.14	27
0		80.0	77.14	27
1		81.0	82.86	29
1		82.0	88.57	31
8		83.0	88.57	31
11		84.0	97.14	34
14		85.0	97.14	34
22		86.0	97.14	34
28		87.0	97.14	34
32		88.0	100.00	35
33				
35				
39				
40				
44				
45				

86.1 dBA(3)
3.35 dBA
Mean: 76.4 dBA(3)
Standard Deviation: 4.07 dBA
Mean of Models:
74 dBA and Above: 77.6 dBA

Diesel Engine, Above 500 cfm Capacities(2)

Standard Models	Percent of Cumulative Units Below	Number of Units Below	dBa Level	Percent of Cumulative Units Below	Number of Units Below
			73.0	0.0 %	0
			74.0	4.17	1
			75.0	8.33	2
			76.0	16.67	4
			77.0	45.83	11
			78.0	58.33	14
			79.0	62.50	15
			80.0	66.67	16
			81.0	70.83	17
			82.0	75.00	18
			83.0	79.17	19
			84.0	79.17	19
			85.0	87.50	21
			86.0	91.67	22
			87.0	100.00	24
86.8	0.0 %	0			
87.8	6.25	2			
88.8	15.62	5			
89.8	28.12	9			
90.8	37.50	12			
91.8	46.87	15			
92.8	53.12	17			
93.8	65.62	21			
94.8	68.75	22			
95.8	68.75	22			
96.8	75.00	24			
97.8	84.37	27			
98.8	87.50	28			
99.8	93.75	30			
100.8	96.87	31			
101.8	100.00	32			

Mean: 92.8 dBA(3)
Standard Deviation: 4.08 dBA
Mean dBA: 78.7 dBA(3)
Standard Deviation: 3.90 dBA
Mean of Models:
76 dBA and Above: 79.6 dBA

ISO 2151-
has treated
is a con-
its for sales
noise
tolerance

data points
tion of the
ntly marketed
incorporating
represent about

model unit

B

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED COST OF QUIETING BASED ON
ANALYSIS OF LIST PRICE DIFFERENTIALS

Power Source Type and Capacity	Current Mean to Level One		Level One to Level Two (All Models)		Level Two to Level Three (All Models)	
	w/o Standard	Tolerance(1) Quieted	w/ Standard	Tolerance(1) Quieted	w/o Tolerance(1)	w/ Tolerance(1)
Gasoline Engine, Below 251 cfm (All)	\$4.15	N/A	\$6.11	\$2.45	\$4.05	\$ 6.43
Diesel Engine, Below 501 cfm	6.19	N/A	8.40	3.19	9.60	13.19
Diesel Engine, Above 500 cfm	5.38	N/A	6.22	1.42	2.40	2.68

Note: (1) Tolerance is the 2 dBA tolerance between the average sound pressure level set "not to exceed" sound levels.

Source: Bolt Beranek and Newman Inc.

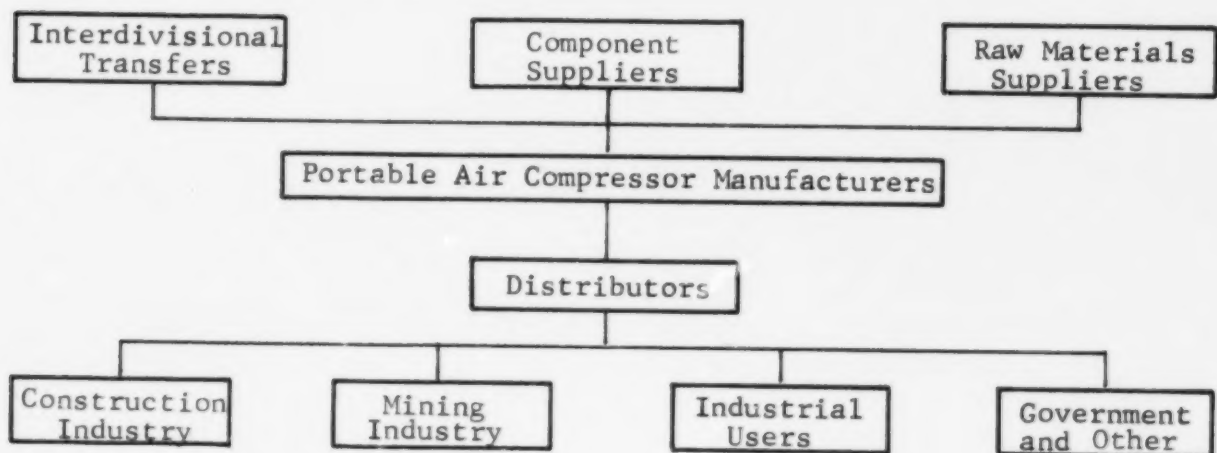
III - INDUSTRY CHARACTERISTICS

This section provides information on the portable air compressor industry which is necessary for the assessment of economic impact. The information presented will also be useful as a source of market data during the regulatory process.

The structure of the portable air compressor industry is schematically outlined in Figure III-1 below:

Figure III-1

Portable Air Compressor Industry Structure



Source: Kearney.

The figure illustrates:

1. Portable air compressor manufacturing operations obtain raw materials and components used in the manufacturing process from interdivisional transfers, component suppliers and raw material suppliers.

2. The primary channel of distribution is through construction equipment distributors (dealers).

3. Distributors sell or lease the product to the primary end users, which are the construction and mining industries, industrial users, government agencies and other users.

This section of the report describes the role of each of these levels of activity in the portable air compressor market. The discussion is organized under the following subject headings:

- . Market Segmentation
- . Product Applications and Competitive Systems
- . Principal End Use Markets
- . Channels of Distribution
- . Characteristics of Firms in the Industry
- . Product Line Offering
- . Size and Nature of the Market
- . Foreign Trade.

MARKET SEGMENTATION

It is necessary to understand portable air compressor competitive market segmentation to facilitate an adequate description and analysis of the industry and assessment of economic impact. Portable air compressors are generally categorized by engine type (diesel or gasoline) and air flow capacity in cubic feet per

minute (cfm). These factors are the primary basis on which to gauge productive capacity and performance.

Capacity of equipment presently on the market ranges up to 2,000 cfm. Units under 75 cfm are excluded from consideration in this study. Kearney's information on the competitive market segmentation indicates that units can best be grouped as indicated below:

Table III-1

Competitive Market Segment Grouping
of Portable Air Compressors by Power Source
Type and Air Flow Capacity

<u>Size Characterization</u>	<u>Power Source Type</u>	<u>Air Flow Capacity Range (cfm)</u>
Small	Gasoline Engine	75-124
Small/Medium	Gasoline Engine	125-250
Small/Medium	Diesel Engine	125-249
Medium	Diesel Engine	250-599
Medium/Large	Diesel Engine	600-899
Large	Diesel Engine	900 and Over

Source: Industry interviews.

These breakdowns represent compressor units which generally are:

1. Competitive in the marketplace.
2. Similar in capabilities.
3. Similar in engine horsepower and fuel requirements.

Kearney's analysis of the portable air compressor market utilizes this breakdown of industry and market characteristics.

PRODUCT APPLICATIONS
AND COMPETITIVE SYSTEMS

A detailed discussion of product applications and competitive systems is presented in Appendix E. The paragraphs below briefly summarize key characteristics.

(a) Product
Applications

Portable air compressors power pneumatic tools at a job site. The prime function of the equipment is based on the principle of the displacement of air to work on or move material. Primary applications include the generation of air power for:

1. Operating hand tools.
2. Tunneling operations.
3. Mixing and atomizing to shoot fine particle material into place.
4. Pneumatic conveying of small particle material.
5. Air-operated centrifugal pumps.
6. Air-powered hoist drums or brakes.
7. Snow production.

(b) Competitive
Systems

Stationary air compressors and power take-off compressors (compressors mounted as an integral part of a truck or other construction equipment) compete with portable air compressors. In

addition, two other systems compete with portable air compressors. These are electric and hydraulic systems. Substitutability depends on capability in specific applications and cost differentials.

Electric systems are competitive with pneumatic systems where there are low energy output requirements. Applications are primarily in the industrial plant.

Hydraulic systems are presently in the development stage. The introduction of a good hydraulic pavement breaker has opened the market for hydraulics in applications formerly dominated by pneumatics in the construction industry. Hydraulic systems will make further inroads as additional tools are developed. At the present time, hydraulic tools are superior in some application areas, and as the technology changes from a developing one to a mature one, more manufacturers will move into this market. Hydraulic systems require on the order of 25% to 50% less power input than pneumatic systems to operate equivalent tools. In addition, the initial total systems costs appear to be 35% to 40% lower at present price levels. User experience is not extensive enough for them to make an adequate assessment of operational and maintenance costs.

Hydraulic systems have some disadvantages which are non-standardization of fittings and other system elements, bulkiness of the hydraulic lines and potential hot oil spills.

As the hydraulic system becomes relatively cheaper in relation to pneumatic systems, hydraulic systems will be increasingly substituted. Furthermore, it will become more feasible to tie up a large piece of equipment (e.g., earthmover) to serve as a power source for several hydraulic tools.

PRINCIPAL END
USE MARKETS

A detailed description of principal end use markets is presented in Appendix F. The paragraphs below briefly summarize key characteristics.

The principal end use markets for portable air compressors are the construction and mining industries, industrial users, government agencies and other users. The table on the following page indicates the estimated distribution of unit shipments by end use market during the years 1967 through 1972.

Table III-2

Estimated Percentage of
Total Portable Air Compressor Unit
Shipments by End Use Market, 1967-1972

<u>End Use Market</u>	<u>Percentage of Units Shipped</u>
Construction Industry	
Public Works and Other Non-Building Construction	50%
Commercial, Institutional and Industrial Building Construction	20
Mining Industry	8
Industrial Users	7
Government Agencies	12
Other Users	<u>3</u>
Total	<u>100%</u>

Sources: Based on manufacturers' product shipments, 1967-1972
and Kearney estimates.

The table indicates that:

1. The construction industry is the principal user of portable air compressors. This end use market represents approximately 70% of total shipments. The public works and other non-building construction sector accounts for approximately 50% of total shipments and the commercial, institutional and industrial building construction sector accounts for approximately 20% of total shipments.

2. Government agencies are the second largest end use market with approximately 15% of total shipments.

3. Mining and industrial users are significant market factors accounting for 8% and 7% of the total shipments respectively.

CHANNELS OF DISTRIBUTION

Characteristics of portable air compressor channels of distribution and end user marketing are discussed in detail in Appendix G. The paragraphs below summarize the most important factors.

(a) Predominant Distribution Methods

The most predominant portable air compressor channels of distribution are indicated in the table below:

Table III-3

Percent of Portable Air Compressor Sales Derived from Each Distribution Method

<u>Distribution Method</u>	<u>Percent of Unit Sales</u>
Factory branches and factory-owned distributors (dealers)	25%
Independent authorized distributors (dealers)	70
Direct sales to end user	<u>5</u>
Total	<u>100%</u>

Sources: Based on manufacturer responses and Kearney estimates.

Note that independent authorized distributors account for 70% of unit sales. These are primarily construction equipment distributors with a major equipment franchise. Air compressors are generally a secondary product line.

The largest manufacturers have a good system of factory branch outlets. In addition, a few manufacturers have a strong, independent authorized distributor system with good national coverage. The strength of distributor organizations varies by region and by compressor lines carried.

(b) Rental and
Used Equipment

Rental equipment is an extremely important factor in the portable air compressor market. Most rental operations are run by distributors or factory branches. In excess of 50% of portable air compressor manufacturer shipments of new equipment reach the end user via rental or rental/purchase agreements. The primary reason for such a high portion of portable air compressor rentals is intermittent requirements for their use. A typical end user might have some applications that necessitate the use of more than one compressor and others where no compressor is needed. Presently, a strong trend is evident toward increased rental of portable air compressors.

Used equipment plays an important role in the portable air compressor market. A high percentage of new sales include a trade-in transaction. Used equipment is sold by distributors from rental equipment or trade-in inventories, or sold on the market by owners.

Small portable air compressors generally have an expected life of 8 to 10 years and larger compressors 10 to 15 years.

Beyond these typical periods, maintenance expense and downtime may become prohibitive at which point it is usually economical to replace the equipment. Over this expected life, portable air compressors may have as many as three owners.

CHARACTERISTICS OF THE
FIRMS IN THE INDUSTRY

Manufacturers of portable air compressors vary significantly in size, financial strength, manufacturing capability, applied technology, marketing ability and extent of product diversification. Kearney identified 17 manufacturers currently active in the domestic market. Two of these import components and assemble units in the United States and one imports completely assembled units.

(a) Financial Characteristics
of Firms in the Industry

Exhibit III-1 presents a detailed summary of portable air compressor manufacturer and parent corporation financial characteristics. Estimates of the 1972 dollar value of portable air compressor sales by manufacturer are summarized in Table III-4 on the following page.

Table III-4

Estimated Sales of Portable Air Compressors
by Major Manufacturer, 1972

<u>Manufacturer</u>	<u>Millions of Dollars</u>
American Jenbach	\$.5 - 2.0
Atlas Copco	.5 - 2.0
Chicago Pneumatic	2.5 - 4.5
Davey	.5 - 2.0
Gardner-Denver	18.0 - 21.0
Grimmer-Schmidt	.5 - 2.0
Ingersoll-Rand	25.0 - 28.0
Jaeger	6.5 - 8.5
Joy	9.0 - 11.0
Kent Air Tool	.5 - 2.0
Le Roi	2.5 - 4.5
Lindsay	.5 - 2.0
Quincy	.5 - 2.0
Schramm	5.5 - 7.5
Gordon Smith	.5 - 2.0
Sullair	2.5 - 4.5
Worthington	4.5 - 6.5

Source: Exhibit III-1.

The table indicates that:

1. Ingersoll-Rand and Gardner-Denver had 1972 portable air compressor sales in excess of \$18 million.
2. Jaeger, Joy, Schramm and Worthington had 1972 portable air compressor sales in excess of \$4 million.
3. Chicago Pneumatic, Le Roi and Sullair had 1972 portable air compressor sales in excess of \$2 million.

Nine of the 17 manufacturers are divisions or subsidiaries of very large corporations with assets in excess of \$100 million. These are Atlas Copco (importer), Chicago Pneumatic, Davey, Gardner-Denver, Ingersoll-Rand, Joy, Le Roi, Quincy and Worthington. Sales of these corporations (parent company) in 1972 ranged

from \$182 to \$906 million. These corporations are not highly specialized in the construction equipment industry. They are extensively diversified, producing a wide variety of products sold in other industries.

Three medium-sized manufacturers have assets ranging from \$6 million to \$15 million. These are Jaeger, Schramm and Sullair (importer). Sales of these corporations in 1972 ranged from \$10 million to \$18 million. Five manufacturers are small companies with assets ranging from \$.3 million to \$1.5 million. They are American Jenbach (importer), Grimmer-Schmidt, Kent Air Tool, Lindsay and Gordon Smith. The medium- and small-sized manufacturers typically specialize in portable and stationary compressors and a few other products sold primarily outside the construction equipment market.

The firms with large portable air compressor sales, large resources and a strong financial position are not expected to make a significant effort to expand their share of the total portable air compressor business. The reasons given are that the portable air compressor market is mature, growing at a moderate rate, and is extremely competitive. Furthermore, profit margins are not generally the most attractive when alternative investment opportunities are considered. The stronger portable air compressor firms also manufacture other product lines which require allocations of their resources.

(b) Characteristics of
Manufacturing Plants

Portable air compressor manufacturing facilities are concentrated in the Northeast and North Central United States. Plants vary considerably in terms of size, efficiency, technology and employment. Detailed plant location, employment, and factory production information is presented in Exhibit III-2. While some firms have efficient plants utilizing the most up-to-date technology and production methods, others have old, inefficient plants utilizing technology and production methods that are obsolete. Generally, the larger manufacturers own the efficient plants and the smaller manufacturers own the more inefficient plants in this industry.

Most manufacturers utilize only one plant for the production of portable air compressors. Generally, these plants are also used for the production of related products including stationary air compressors. Although each plant usually manufactures more than one product, each product is typically manufactured on a separate production line or in a separate area.

A detailed discussion of the portable air compressor production process and component supply patterns is presented in Appendix H. Portable air compressor manufacturers typically manufacture the air compression unit (air end) and frame, but purchase the rest of the compressor components from outside suppliers. They assemble the final product from these components.

Material cost is generally a higher portion of final production costs in the smaller units. Industry respondents indicate that on the average, final production costs run about as follows: 40% to 60% material cost, 5% to 20% direct labor cost, and 20% to 40% indirect labor, overhead, sales, general and administrative cost depending on the cost system used.

The portable air compressor industry generally operates at about 65% to 75% of capacity. However, during 1973 this industry was operating at about 85% of capacity. Although capacity can be adjusted to meet cyclical peaks in demand, this industry would still be faced with the difficulty of obtaining deliveries of engines and other components.

Prior to the 1972-1973 period, portable air compressor delivery times averaged from four to eight weeks depending on power source type and air flow capacity. In 1973, delivery times averaged six to nine months.

Approximately 9,000 to 10,000 people are employed in plants which manufacture portable air compressors. The exact employment attributable to the production of portable air compressors by plant was considered confidential. Kearney estimates total portable air compressor production employment to be in the range of 2,000 to 3,000.

PRODUCT LINE
OFFERING

Each of the 17 portable air compressor manufacturers offers a different product line. Exhibits III-3, III-4 and III-5 classify the product line offerings by manufacturer, compressor type, capacity and engine horsepower. Exhibit III-6 indicates the product line offering of each manufacturer by model.

The product line participation of manufacturers by market segment is summarized in the table on the following page.

Table III-5

Product Line Offerings by Market Segment

Manufacturer	Market Segment					
	Gasoline Engine		Diesel Engine			
	75-124 (1)	125-250 (1)	125-249 (1)	250-599 (1)	600-899 (1)	900 and Over (1)
American Jenbach	X		X			
Atlas Copco	X		X	X	X	X
Chicago Pneumatic	X	X	X	X	X	X
Davey Compressor	X	X	X	X	X	
Gardner-Denver	X	X	X	X	X	X
Grimmer-Schmidt	X	X	X	X	X	X
Ingersoll-Rand	X	X	X	X	X	X
Jaeger	X	X	X	X	X	X
Joy Manufacturing	X	X	X	X	X	X
Kent Air Tool	X	X	X			
Le Roi	X	X	X	X	X	X
Lindsay	X	X	X			
Quincy		X	X	X	X	X
Schramm	X		X	X	X	
Gordon Smith	X					
Sullair	X	X	X	X	X	X
Worthington	X	X	X	X	X	X

Note: (1) Air flow capacity category (cfm).

Source: Exhibits III-3, III-4 and III-5.

Note that:

1. Thirteen manufacturers compete in nearly all market segments.

2. Four manufacturers (American Jenbach, Gordon Smith, Kent Air Tool and Lindsay) have a limited product line covering only the lower capacity market segments.

Three basic technologies are used to compress air. These are described in detail in BBN's report "Portable Air Compressors: The Costs, Benefits, and Penalties of Reducing Their Noise." All three technologies have been commercialized

and are used as the air compression system for portable air compressors. Based on these technologies, the three basic portable air compressor types are: rotary screw, reciprocating and rotary vane. Rotary screw compressors dominate the 600 cfm and over market. Rotary vane types are used in all size ranges up to 900 cfm. Reciprocating units are primarily used in the lower cfm capacities.

Manufacturers tend to compete by specializing in one or two types of portable air compressors in each market segment. This is demonstrated by the data presented in Exhibits III-3, III-4 and III-5. Table III-6 below summarizes the types of compressors offered by each portable air compressor manufacturer.

Table III-6

Type of Compressor Offered by Manufacturer

<u>Manufacturer</u>	<u>Rotary Screw</u>	<u>Reciprocating</u>	<u>Rotary Vane</u>
American Jenbach		X	
Atlas Copco	X	X	
Chicago Pneumatic	X		X
Davey Compressor			X
Gardner-Denver	X		X
Grimmer-Schmidt		X	
Ingersoll-Rand	X		X
Jaeger	X		X
Joy Manufacturing	X		X
Kent Air Tool			X
Le Roi	X		X
Lindsay		X	
Quincy	X		
Schramm		X	
Gordon Smith		X	
Sullair	X		
Worthington	X		X

Source: Exhibits III-3, III-4 and III-5.

From the table it can be concluded that:

1. No manufacturer offers all three portable air compressor types.
2. Nine manufacturers offer two portable air compressor types.
3. Eight manufacturers offer only one type of portable air compressor.

From the data in Exhibit III-6 it can also be noted that:

1. No gasoline engine units are manufactured with air flow capacity over 250 cfm.
2. No units are manufactured in the air flow capacity range of 451-599 cfm.

Most manufacturers currently offer quieted portable air compressors due to customer demand resulting from OSHA and local noise regulations. Domestic shipments of quieted units vary by air flow capacity and power source type as shown in the table below:

Table III-7

Estimated Shipments of Quieted Portable Air Compressors
as a Percent of Total Unit Shipments by Market Segment

<u>Power Source Type</u>	<u>Market Segment Air Flow Capacity Range (cfm)</u>	<u>Estimated Percent of Total Shipments</u>
Gasoline Engine	75-124	20%
Gasoline Engine	125-250	20
Diesel Engine	125-249	20
Diesel Engine	250-599	20
Diesel Engine	600-899	10
Diesel Engine	900 and Over	10

Sources: Field survey interviews and
Kearney estimates.

The quieted units as a percent of total domestic shipments are greater in the small capacity units, because a substantially larger investment is required to obtain quieting in the larger capacity units.

SIZE AND NATURE
OF THE MARKET

(a) Market
Position

The portable air compressor industry is a mature industry and extremely competitive. Competition is on the basis of new product innovation, product quality, price and delivery. The most dominant form of competition is price.

Ingersoll-Rand and Gardner-Denver are the largest factors in the market. Table III-8 indicates the estimated market share by manufacturer.

Table III-8

Estimates of Portable Air Compressor
Manufacturer Market Share

<u>Manufacturer</u>	<u>Percent of Total Portable Air Compressor Unit Sales</u>
Ingersoll-Rand	25% - 36%
Gardner-Denver	20 - 25
Joy	10 - 15
Jaeger	5 - 10
Schramm	5 - 10
Worthington	5 - 7
Le Roi	3 - 5
Chicago Pneumatic	3 - 5
All Others	6 - 10

Source: Kearney estimates.

The market share information in the table shows that:

1. Eight portable air compressor manufacturers have over 90% of the market.
2. Ingersoll-Rand and Gardner-Denver together have about 50% of the market. Joy ranks third with about 10%-15% share.
3. No other manufacturer has more than 10% of the market.

(b) Pricing

All portable air compressor pricing is based on discounts from published list prices. The manufacturers' published discount schedule typically ranges from 20% to 25%. However, discounts to distributors can vary from 15% to 45% depending on volume and other transaction factors. Discount practices do not vary by size of unit, type, or quiet versus standard model.

According to the United States Department of Commerce, prices of portable air compressors rose 24% between 1967 and 1972, or at a compound annual rate of 4.4%. This upward trend of prices is expected to continue because of rising material and labor costs and because the industry's products are becoming more complex.

A detailed compilation and analysis of portable air compressor list prices has been made in Exhibits III-7 through III-12. In summary, average prices of portable air compressors by power source type and air flow capacity are the following.

Table III-9Estimates of Portable Air Compressor
Average List Prices--All Models

<u>Power Source Type and Air Flow Capacity (cfm)</u>	<u>Estimated Average List Price</u>
75-124 Gasoline	\$ 3,982
125-250 Gasoline	5,741
125-249 Diesel	6,791
250-599 Diesel	17,509
600-899 Diesel	29,376
900- and Over Diesel	48,918

Source: Exhibit III-11.

(c) Dollar Volume

Sales of portable air compressors are sensitive to government and private funding of construction activity. Sales of large units have historically followed trends in the construction industry while smaller units have followed the general economy. Dollar value of portable air compressor shipments has fluctuated between \$58.7 million and \$89.7 million during the years 1967-1972. Portable air compressor sales are projected to reach approximately \$93 million during 1973. Table III-10, on the following page, shows the value of total portable air compressor shipments during the 1967-1972 period. Discrepancies exist between Table III-10 and United States Department of Commerce data. These are explained in Appendix I - Calculation of Unit and Dollar Shipments of Portable Air Compressors.

Table III-10Estimated Dollar Value of Annual Shipments of
Portable Air Compressors, 1967-1972(1)

<u>Year</u>	<u>Value of Shipments</u>
1967	\$58,700,000
1968	59,915,000
1969	75,295,000
1970	70,634,000
1971	74,131,000
1972	89,732,000

Note: (1) Figures are in current dollars.

Source: Appendix I.

From the data in the above table, it should be noted that:

1. Shipments in 1972 were \$89.7 million. This was up from a level of \$58.7 million in 1967.

2. The year-to-year differences in the value of shipments are significant. Large increases were experienced in 1969 and 1972; moderate increases occurred in 1968 and 1971; and 1970 shows a moderate decline.

A detailed breakdown of the annual value of shipments of portable air compressors by power source type and air flow capacity category is presented in Appendix I.

Industry measurements for sales of portable air compressors are in dollars and units. Dollar value is not an accurate form of relative importance due to inflation and industry price increases based on improved features and performance. Furthermore, dollar sales by size category provide a distorted view of the market due to the high purchase price of the larger units. In

the larger size categories, a relatively few units contribute a large sales volume. Unit sales provide a clearer picture of this market. Therefore, subsequent market descriptions, breakdowns and projections are primarily measured in units.

(d) Unit
Volume

Portable air compressor unit shipments during the past six-year period are shown in Table III-11.

Table III-11

Total Portable Air Compressor
Unit Shipments, 1967-1972

<u>Year</u>	<u>Unit Shipments</u>	<u>Yearly Percent Change</u>
1967	9,969	-
1968	9,719	(2.5%)
1969	12,277	25.8
1970	9,973	(18.8)
1971	9,901	(.7)
1972	12,154	22.8

Source: Appendix I.

From the table note that total unit sales of portable air compressors fluctuated between 9,719 and 12,277 during the period. Table III-12 on the following page breaks down 1972 portable air compressor sales by power source type and air flow capacity.

Table III-12

Portable Air Compressor 1972
Sales by Power Source and
Air Flow Capacity(1)

<u>Power Source Type and Air Flow Capacity(cfm)</u>	<u>Unit Shipments</u>	<u>Percent of Total</u>
75-124 Gasoline	3,082	25.4%
125-250 Gasoline	4,827	39.7
125-249 Diesel	2,101	17.3
250-599 Diesel	576	4.7
600-899 Diesel	1,095	9.0
900 and Over Diesel	<u>473</u>	<u>3.0</u>
Total	<u>12,154</u>	<u>100.0%</u>

Note: (1) Detailed unit shipment data by power source type and air flow capacity category for the years 1967-1972 are presented in Appendix I.

Source: Appendix I.

The table indicates that:

1. Approximately 65% of unit shipments in 1972 consisted of gasoline engine units.
2. Diesel units accounted for approximately 35% of 1972 shipments. Of these about one-half were 125-249 cfm, about one-quarter were 600-899 cfm, about one-eighth were 250-599 cfm, and one-eighth 900 and over cfm.

Furthermore, the following trend in portable air compressor shipments has occurred during the 1967-1972 period:

1. The market share of the diesel engine, 250 cfm and over units has remained fairly constant.
2. The market share of gasoline engine, 75-124 cfm units has increased.

3. The market share of diesel engine, 125-249 cfm units has increased.

4. The market share of gasoline engine, 125-250 cfm units has decreased. A detailed explanation of the reasons for these market share shifts appears in Appendix K.

Portable air compressors with the smaller air flow capacities (75 cfm to 250 cfm) generally have an expected life of 8 to 10 years before scrapping. The larger compressor (above 250 cfm) have an expected life of 10 to 15 years. Industry respondents estimate that there are approximately 100,000 portable air compressors currently in use in the United States. This estimate is consistent with independent estimates of life and production figures. Of all units, about 65,000 have gasoline engines and 35,000 have diesel engines.

FOREIGN TRADE

A detailed description of exports and imports is presented in Appendix J. The paragraphs below summarize key characteristics.

(a) Exports

Exports to the great majority of foreign nations consist chiefly of the larger, more sophisticated portable air compressors which are not manufactured in many foreign countries. In addition, significant exports are made to Canada and Mexico. The power source and air flow capacity distribution of the latter units is about the same as units sold in the United States. Domestic

firms offering early deliveries and reliable service are the most successful exporters.

Exports of portable air compressors have accounted for 6% to 13% of total annual shipments depending on market conditions. Table III-13 indicates the unit and dollar volume of portable air compressor export shipments over the period 1969-1972.

Table III-13

Portable Air Compressor Exports, 1969-1972
(75 cfm and Above)

<u>Year</u>	<u>Units</u>	<u>Percent Total Shipments</u>	<u>Value (\$ 000's)</u>	<u>Percent of Total Shipments</u>
1969	1,566	12.8%	\$17,900	23.8%
1970	667	6.7	8,000	11.3
1971	797	8.1	10,100	13.6
1972	1,355	11.1	17,500	19.5

Sources: United States Department of Commerce, Current Industrial Reports: Pumps and Compressors; and Kearney estimates.

From the data in the above table note that:

1. Annual dollar value of exports of portable air compressors ranged from a low of \$8.0 million to a high of \$17.9 million. This was 11.3% to 23.8% of the total value of shipments.
2. Unit exports ranged from 667 to 1,566. This was 6.7% to 12.8% of total shipments.
3. Exports represented a greater portion of total shipments in those years where larger total export shipments occurred.
4. Exports exhibit a cyclical pattern for this period.

(b) Imports

Presently, imports are not a significant factor in the portable air compressor market. Imports represented less than 7% of industry unit volume in 1972. This included Sullair and American Jenbach which import components and assemble the finished product in the United States. Excluding Sullair and American Jenbach, 1972 imports represented less than 4% of industry unit volume.

Eighteen import brands are identified in Appendix J. Of these only American Jenbach, Atlas Copco and Sullair are considered by domestic portable air compressor manufacturers as serious domestic competition.

Imported portable air compressor prices are generally competitive or lower than domestic manufacturers' prices. Excluding Atlas Copco, Sullair and American Jenbach, imports have not significantly penetrated the United States portable air compressor market, primarily because foreign manufacturers have not successfully established distribution networks. Their difficulty in establishing distribution is due to the following factors:

1. A reputation for poor product quality.
2. Poor service and parts delivery.
3. Intense competition by domestic portable and compressor manufacturers.

THE ENVIRONMENTAL PROTECTION AGENCY
PORTABLE AIR COMPRESSOR MANUFACTURER
FINANCIAL DATA, 1972
(Millions of Dollars)

Manufacturer (1)	Financial Data (2)				Comments
	Portable Air Compressor Sales	Parent Company Sales	Parent Company Assets	Net Worth	
American Jenbacher Corp.	\$.5 - 2.0	\$ 0.7	N/A	\$ 0.3	\$ 0.1
Atlas Copco, Inc. (Sub, Atlas Copco A.B., Stockholm)	.5 - 2.0	332.5	N/A	388.1	468.1
Chicago Pneumatic Equip. (Subs, Chicago Pneumatic Tool)	2.5 - 4.5	184.9	314.7	186.7	137.7
Davey Compressor Co. (Subs, Alco Std. Corp)	.5 - 2.0	646.7	12.5	338.4	151.0
Gardner-Denver Co.	18.0 - 21.0	209.7	22.9	194.7	184.7
Grinner-Schmidt Corp.	.5 - 2.0	.9	(loss)	N/A	N/A
Ingersoll-Rand Company	25.0 - 28.0	872.0	60.1	844.3	505.4
Jaeger Machine Co., The	6.5 - 8.5	15.2	(.5)	15.0	9.7
Joy Manufacturing Co. Air Power Division	9.0 - 11.0	323.8	14.0	249.1	157.2
Ken Air Tool Co.	.5 - 2.0	2.4	N/A	1.5	.8
Le Roi Division (Dresser Industries, Inc.)	2.5 - 4.5	906.9	38.9	748.8	353.5
Lindsay, P.K., Co.	.5 - 2.0	1.7	N/A	.9	.8
Quincy Compressor Division (Colt Industries Inc.)	.5 - 2.0	707.3	16.3	619.3	257.3
Schramm, Inc.	5.5 - 7.5	10.5	N/A	8.2	5.1
Smith, Gordon & Co.	.5 - 2.0	1.7	N/A	.9	.5
Sullair Corp.	2.5 - 4.5	18.1	1.1	13.3	6.3
Worthington C.E.I., Inc. (Sub, of Worthington Corp. and of Studebaker-Worthington, NYC)	4.5 - 6.5	879.4	31.3	876.5	302.2

Notes: (1) Includes only those manufacturers producing portable air compressors over 75 cfm.

(2) Figures are for year ending 12/31/72 unless otherwise stated in the Comments column.

Sources: Construction Equipment Buyers Guide, Conover-Nast, April, 1973.

Manufacturers' annual reports, Dun & Bradstreet reports, and Fortune's "Double 500" and "300 Directory."

Comments

Figures are for year ending 11/30/72.

Figures are for year ending 9/30/72.

Incomplete data obtained estimate annual sales at the \$900,000 and up level.

Net income was affected by an extraordinary charge of at least 10%.

Figures are for year ending 9/26/72. The Air Power Division is part of the Mining Equipment Group which accounted for 49% of sales.

Figures are for year ending 12/31/72.

Figures are for year ending 10/31/72. This division was formerly HAWCO Pneumatic Equipment Division.

Figures are for year ending 12/31/71. Portable air compressors represent 75% of sales.

Figures are for year ending 12/31/71.

Air compressors account for 97% of sales.

Worthington C.E.I. manufactures compressors, engines, generators and contractors' tools; its sales are \$90 million.

THE ENVIRONMENTAL PROTECTION AGENCY

PORTABLE AIR COMPRESSOR
PLANT AND EMPLOYMENT STATISTICS

Manufacturer	Plant Location	Products Manufactured at This Plant	Type of Production Activity	Employment
American Jenbacher Corp.	Burlington, North Carolina	Portable air compressors	Fabrication and Assembly	32
Atlas Copco, Inc. Subs. Atlas Copco A.B. Stockholm	Foreign	-	-	-
Chicago Pneumatic	Franklin, Pennsylvania	Portable air compressors, stationary compressors, drill- ing rigs, rock drilling products	Fabrication and Assembly	1,050
Davey Compressor	Kent, Ohio	Portable air compressors, drill rigs	Fabrication and Assembly	200
Gardner-Denver	Quincy, Illinois	Reciprocical pumps, portable air compressors	Fabrication and Assembly	1,900
	Dallas, Texas	Heavy machinery, water wells drilling equipment	Fabrication and Assembly	700
Grüner-Schmidt Corp.	Franklin, Indiana	Portable air compressors	Fabrication and Assembly	60
Ingersoll-Rand	Mocksville, North Carolina	Portable air compressors, stationary compressors	Fabrication and Assembly	-
Jaeger	Columbus, Ohio	Portable air compressors, concrete miners, water pump	Fabrication and Assembly	300
Joy Manufacturing Co.	Michigan City, Indiana	Portable air compressors, stationary compressors	Fabrication and Assembly	800
	Clairmont, New Hampshire	Portable air compressors, stationary air compressors, components, rock drills	Fabrication and Assembly	900
Kent Air Tool Co.	Kent, Ohio	Portable air compressors, molds, air tools, extruders, presses	Fabrication and Assembly	400
Le Roi Division (Dresser Industries)	Sidney, Ohio	Air tools, portable air compressors, rock drills, pneumatic drills	Fabrication and Assembly	600
Lindsay, P.K., Co.	Deerfield, New Hampshire	Portable air compressors, sand blasting equipment	Fabrication and Assembly	60
Quincy Compressor Division (Colt Industries Inc.)	Quincy, Illinois	Portable air compressors, hydraulic systems, pneumatic and hydraulic tools	Fabrication and Assembly	700
Schramm, Inc.	West Chester, Pennsylvania	Portable air compressors, stationary compressors, drilling equipment	Fabrication and Assembly	360
Smith, Gordon & Co.	Bowling Green, Kentucky	Portable air compressors	Fabrication and Assembly	25
Sullair Corp.	Michigan City, Indiana	Portable air compressors	Assembly	290
Worthington CEI, Inc.	Holyoke, Massachusetts	Portable air compressors, stationary compressors, drilling equipment, hydraulic systems, construction tools	Fabrication and Assembly	825

THE ENVIRONMENTAL PROTECTION AGENCY
PORTABLE AIR COMPRESSOR MANUFACTURER PRODUCT LINES

Rotary Screw Compressors

Compressor Manufacturer	Air Flow Capacity (cfm)/Horsepower															
	85	101	150	160	175	185	250	325	365	375	450	600	650	700	750	800
Atlas Copco									115			190		278		
Chicago Pneumatic																
Gardner-Denver	X		X			X	X	X			X					
Ingersoll-Rand					70	72							228		228	
Jaeger					X	X										
Joy						68							212			
Le Roi						63										
Quincy				71								190		238		
Sullair	X	51	65	71	70		112	125				215				
Worthington					68		97									

93
72

Source:
Exhibit III-6.

- top number (93) is h.p. specification for gasoline engines where existing.
- bottom number (72) is h.p. specification for diesel engines where existing.
- X - indicates data not available for that model.

EXHIBIT III-3

EXHIBIT III-4

- top number (93) is h.p. specification for gasoline engines where existing.
- bottom number (72) is h.p. specification for diesel engines where existing.

X - indicates data not available for that model.

Source:
Exhibit III-6.

EXHIBIT III-5

- top number (93) is h.p. specification for gasoline engines where existing.
- bottom number (72) is h.p. specification for diesel engines where existing.

X - indicates data not available for that model.

Kearney Management Consultants

ENVIRONMENTAL PROTECTION AGENCY
IDENTIFICATION OF PORTABLE AIR COMPRESSOR
MODELS BY MANUFACTURER

Manufacturer/Model	Air Flow Capacity(1) (cfm at 100 psi)	Compressor Type(2)	Type	Engine Make/Model	Rated Horsepower
American Jenbach					
JW78L	78	Reciprocating	Gas		
JW156L	156	Reciprocating	Diesel	/JW40L	40
Atlas Copco					
VT-2 *	85	Reciprocating	Gas		
VT-3	125	Reciprocating	Diesel	Deutz/F3L9L12	35
VT-4	170	Reciprocating	Diesel	Deutz/F4L9L12	48
VT-5	250	Reciprocating	Diesel	Deutz/F6L9L12	70
VT-6	335	Reciprocating	Diesel	Deutz/F6L514	94
PR-365	365	Rotary Screw	Diesel	Deutz/F6L714	115
PK-600	600	Rotary Screw	Diesel	G.M./6V71	190
PR-700	700	Rotary Screw	Diesel	Deutz/F10L413	221
PRH-700	700*	Rotary Screw	Diesel	G.M./8V71	284
PT900	900	Rotary Screw	Diesel	G.M./8V71	284
PT1200	1,200	Rotary Screw	Diesel		284
Chicago Pneumatic					
85	85	Rotary Vane	Gas		
125	125	Rotary Vane	Gas		
175	175	Rotary Vane	Gas	Ford/C5PG	93
175	175	Rotary Vane	Diesel	G.M./3-53	72
250	250	Rotary Vane	Gas	Herc./G3400	105
250	250	Rotary Vane	Diesel	G.M./4-53	90
365	365	Rotary Vane	Diesel	G.M./4-71	125
600	600	Rotary Vane	Diesel	G.M./6-71	197
750	750	Rotary Screw	Diesel	Cat./D-333C-T	291
900	900	Rotary Vane	Diesel	G.M./8V-71N	278
1200	1,200	Rotary Screw	Diesel	G.M./12V71N	410
Davey					
85PVC	85	Rotary Vane	Gas		
125PVC	125	Rotary Vane	Gas	IH/UC153	54
125PVC	125	Rotary Vane	Diesel	Herc./D2000	61
150PVC	150	Rotary Vane	Gas	IH/C200	82
150PVC	150	Rotary Vane	Diesel	Herc./D2300	84
190PVC	190	Rotary Vane	Gas	Ford/200GF	82
190PVC	190	Rotary Vane	Diesel	Ford/256DF	84
200PVC	200	Rotary Vane	Gas	Herc./G2300	76
200PVC	200	Rotary Vane	Diesel	G.M./3-53	70
250RPV	250	Rotary Vane	Gas	Herc./G3400	98
250RPV	250	Rotary Vane	Diesel	G.M./4-53	85
400RPV	400	Rotary Vane	Diesel	G.M./4-71	101
600RPV	600	Rotary Vane	Diesel	G.M./6-71	255
750RPV	750	Rotary Vane	Diesel	Cat./D333C-T	287

IDENTIFICATION OF PORTABLE AIR COMPRESSOR
MODELS BY MANUFACTURER

Manufacturer/Model	Air Flow Capacity(1) (cfm at 100 psi)	Compressor Type(2)	Type	Engine Make/Model	Rated Horsepower
Gardner-Denver					
SP85V	85	Rotary Vane	Gas	-	-
SP85G	85	Rotary Screw	Gas	Int./VCI35B	-
SPH	150	Rotary Screw	Gas	Ford/V104	-
SPH	185	Rotary Screw	Gas	Ford/240	-
SPH	185	Rotary Screw	Gas	Ford/254	-
SPKD	325	Rotary Screw	Diesel	G.M./4-53	-
SPND	450	Rotary Screw	Diesel	G.M./4-71N	-
SP600	600	Rotary Screw	Diesel	Cat./D333C-T	-
SPQD	750	Rotary Screw	Diesel	G.M./6-71N	-
SP900	900	Rotary Screw	Diesel	Cat./D343T	-
SPTD	1,050	Rotary Screw	Diesel	Cat./C343T	-
SPI200	1,200	Rotary Screw	Diesel	Cat./D343TA	-
Grimmer-Schmidt					
125G	125	Reciprocating	Gas	Ford/V351C	110
175G	175	Reciprocating	Gas	Ford/V351C	128
190	190	Reciprocating	Diesel	Cummins/V352C	70
280	280	Reciprocating	Diesel	Cummins/V470C	105
380	380	Reciprocating	Diesel	Cummins/V785C	132
450	450	Reciprocating	Diesel	Cummins/V903C	160
750***	750	Reciprocating	Diesel	Cummins/V785C	264
900***	900	Reciprocating	Diesel	Cummins/V903C	320
Ingersoll-Rand					
85	85	Rotary Vane	Gas	-	-
125	125	Rotary Vane	Gas	IH/C200	58
125	125	Rotary Vane	Diesel	G.M./2-53	42
150	150	Rotary Vane	Gas	IH/C200	64
150	150	Rotary Vane	Diesel	G.M./2-53	45
RR160	160	Rotary Vane	Gas	IH/C200	67
RR160	160	Rotary Vane	Diesel	Ford/D254	68
175	175	Rotary Screw	Gas	IH/C200	70
175	175	Rotary Screw	Diesel	G.M./3-53	72
R250	250	Rotary Vane	Diesel	G.M./4-53	88
R365	365	Rotary Vane	Diesel	G.M./4-71	126
R600	600	Rotary Vane	Diesel	G.M./6-71	194
XL650	650	Rotary Screw	Diesel	-	228
XL750	750	Rotary Screw	Diesel	G.M./6V-71N	228
XL750S	750	Rotary Screw	Diesel	G.M./6V-71N	228
XL850	850	Rotary Screw	Diesel	G.M./6V-71N	228
XL900	900	Rotary Screw	Diesel	G.M./8V-71N	280
XL900S	900	Rotary Screw	Diesel	G.M./8V-71N	280
XL1050	1,050	Rotary Screw	Diesel	Cummins/V903	301
XL1100	1,100	Rotary Screw	Diesel	G.M./8V-71N	280
XL1200	1,200	Rotary Screw	Diesel	G.M./12V-71N	380
XL1200S	1,200	Rotary Screw	Diesel	G.M./12V-71N	380

IDENTIFICATION OF PORTABLE AIR COMPRESSOR
MODELS BY MANUFACTURER

Manufacturer/Model	Air Flow Capacity(1) (cfm at 100 psi)	Compressor Type(2)	Engine Make/Model	Rated Horsepower
Ingersoll-Rand (cont.)				
XL1400	1,400	Rotary Screw	Diesel	420
XL1750	1,750	Rotary Screw	Diesel	456
D2000	2,000	Rotary Screw	Diesel	560
Jaeger				
85	85	Rotary Vane	Gas	-
150	150	Rotary Vane	Gas	-
150	150	Rotary Vane	Diesel	-
175	175	Rotary Screw	Gas	-
175	175	Rotary Screw	Diesel	-
250	250	Rotary Vane	Gas	-
250	250	Rotary Vane	Diesel	-
365	365	Rotary Vane	Diesel	-
750	750	Rotary Screw	Diesel	-
900	900	Rotary Vane	Diesel	-
Joy				
RPV100(X)	100	Rotary Vane	Gas	49
RPV150(X)	150	Rotary Vane	Gas	68
RPV150(X)	150	Rotary Vane	Diesel	63
RPS185(X)	185	Rotary Screw	Gas	68
RPS185(X)	185	Rotary Screw	Diesel	63
RP250	250	Rotary Vane	Diesel	90
RP365	365	Rotary Vane	Diesel	122
RPS650(X)	650	Rotary Screw	Diesel	212
RPS800(X)	800	Rotary Screw	Diesel	228
RPS850	850	Rotary Screw	Diesel	250
RPS900(X)	900	Rotary Screw	Diesel	258
RPS1050(X)	1,050	Rotary Screw	Diesel	288
RPS1200(X)	1,200	Rotary Screw	Diesel	388
RPS1600(X)	1,600	Rotary Screw	Diesel	432
Kent				
R-80	80	Rotary Vane	Gas	-
R-150	150	Rotary Vane	Gas	-
R-150	150	Rotary Vane	Diesel	-
Le Roi				
75 RG1	75	Rotary Vane	Gas	40
100 RG1	100	Rotary Vane	Gas	46
130 RG1	130	Rotary Vane	Gas	-
160 RG16D1	160	Rotary Vane	Gas	75
160 RC16D1	160	Rotary Vane	Diesel	63
170 RG2 & D2	170	Rotary Vane	Gas	64
170 RG2 & D2	170	Rotary Vane	Diesel	65
250 RG & D2	250	Rotary Vane	Gas	93

IDENTIFICATION OF PORTABLE AIR COMPRESSOR
MODELS BY MANUFACTURER

Manufacturer/Model	Air Flow Capacity (1) (cfm at 100 psi)	Compressor Type (2)	Type	Engine Make/Model	Rated Horsepower
<u>Le Roi (cont.)</u>					
250 RG & D2	250	Rotary Vane	Diesel	G.M./4-53	82
450 RD2	450	Rotary Vane	Diesel	G.M./4-71	133
600 SD1	600	Rotary Screw	Diesel	G.M./6V-53M	190
750 SD1	750	Rotary Screw	Diesel	G.M./6V-71N	238
900 SD1	900	Rotary Screw	Diesel	G.M./8V-71N	276
1200 SK1	1,200	Rotary Screw	Diesel	G.M./12V-71N	380
<u>Lindsay</u>					
80-H	80	Reciprocating	Gas		-
125-H	125	Reciprocating	Gas	Wisc./V-465D	65
150-A	150	Reciprocating	Gas	Wisc./V-465D	65
175-D	175	Reciprocating	Diesel	Ford/256DF	82
<u>Quincy</u>					
QS-160	160	Rotary Screw	Gas	Herc./G2300	71
QS-160	160	Rotary Screw	Diesel	Herc./D2300	71
QS-250	250	Rotary Screw	Gas	Herc./G3400	112
QS-250	250	Rotary Screw	Diesel	Herc./D3400	108
QS-365	365	Rotary Screw	Diesel	G.M./4-71N	125
QS-600	600	Rotary Screw	Diesel	G.M./6V-71N	215
QS-900	900	Rotary Screw	Diesel	G.M./8V-71N	280
QS-1200	1,200	Rotary Screw	Diesel	G.M./12V-71N	410
<u>Schramm</u>					
P100	100	Reciprocating	Gas	Schramm/OUH	31
P125	125	Reciprocating	Diesel	Schramm/DOUH	41
S125D	125	Reciprocating	Diesel	Schramm/DOUG	41
P160	160	Reciprocating	Gas	Schramm/OUHB	50
S160	160	Reciprocating	Gas	Schramm/OUHB	50
HT160	160	Reciprocating	Gas	Schramm/OUHB	50
PA250	250	Reciprocating	Diesel	G.M./4-71	87
PA375	375	Reciprocating	Diesel	G.M./6V-71	160
PA600	600	Reciprocating	Diesel	G.M./8V-71	216
<u>Gordon Smith</u>					
100-P	100	Reciprocating	Gas	Ford/302	40
140-P	140	Reciprocating	Gas	Ford/429	75
<u>Sullair</u>					
85	85	Rotary Screw	Gas		-
101+	101	Rotary Screw	Gas	Ford/91	51
150	150	Rotary Screw	Gas	Ford/172D	65
150	150	Rotary Screw	Diesel	Ford/172DD	59
175	175	Rotary Screw	Gas	IH/C200	70
175	175	Rotary Screw	Diesel	G.M./Bed.220	68

IDENTIFICATION OF PORTABLE AIR COMPRESSOR
MODELS BY MANUFACTURER

Manufacturer/Model	Air Flow Capacity(1) (cfm at 100 psi)	Compressor Type(2)	Engine		Rated Horsepower
			Type	Make/Model	
<u>Sullair (cont.)</u>					
250+	250	Rotary Screw	Diesel	G.M./4-53	97
375	375	Rotary Screw	Diesel	G.M./4-53N	117
750	750	Rotary Screw	Diesel	G.M./6V-71N	228
1050	1,050	Rotary Screw	Diesel	G.M./8V-71N	301
1600	1,600	Rotary Screw	Diesel	G.M./12V-71N	456
<u>Worthington</u>					
85	85	Rotary Vane	Gas	IH	46
125	125	Rotary Vane	Gas	IH/C175	64
160	160	Rotary Vane	Gas	IH/C200	75
160	160	Rotary Vane	Diesel	G.M./Bed. 220	65
175	175	Rotary Vane	Gas	Herc./G2300	81
175	175	Rotary Vane	Diesel	Herc./D2300	69
250	250	Rotary Vane	Diesel	CM/4-52	93
365	365	Rotary Vane	Diesel	G.M./4-71	123
600	600	Rotary Vane	Diesel	Cummings/NH250	196
750	750	Rotary Vane	Diesel	G.M./8V-71N	278
750	750	Rotary Screw	Diesel	G.M./DD6V-71	228
850	850	Rotary Screw	Diesel	G.M./DD6V-71T	250
900	900	Rotary Vane	Diesel	G.M./8V-71N	304
1100	1,100	Rotary Screw	Diesel		

Notes: (1) Most published data include only those models with air delivery ratings of over 100 cfm for preliminary information on smaller capacity models. Other data noted as available.

(2) Types are identified as follows: Reciprocating (piston type), Rotary Vane, and Rotary Screw. Compressors may be one-, two-, or multiple-stage with 2- or 4-wheel mounting.

*Delivered at 150 psi.

**All Atlas Copco models are a one-hour rating.

***Twin diesel.

Sources: Construction Methods and Equipment, "Specs for Your Files," McGraw-Hill, 1974; and manufacturers' product literature.

THE ENVIRONMENTAL PROTECTION AGENCY
CALCULATION OF STANDARD PORTABLE AIR
COMPRESSOR AVERAGE CURRENT
LIST PRICES

Power Source Type and Air Flow Capacity (cfm) of Predominant Units	Manufacturer Designation					Average List Price
	A	B	C	D	E	
85 Gasoline	\$ 3,850	\$ 3,820	\$ 3,860	\$ 3,835	\$ 4,305	\$ 3,853
100 Gasoline						4,083
125 Gasoline	5,200	5,585		5,210		5,332
160 Gasoline	5,700	5,585	5,370	5,720	5,620	5,599
185 Gasoline	6,200	6,195	6,210	6,200		6,201
125 Diesel	6,150				6,400	6,275
160 Diesel	6,600		6,360	6,620		6,527
185 Diesel	7,350	7,195	7,210	7,310		7,266
250 Diesel	13,000		12,900	13,000	13,075	12,994
365 Diesel	19,000		18,100	18,900	18,690	18,673
600 Diesel	26,400	27,030	26,100	26,300	25,095	26,185
750 Diesel	32,300	31,385	31,380	32,250		31,829
900 Diesel	41,600		39,900	38,100		39,867
1,050 Diesel	46,000	45,925	45,900			45,942
1,200 Diesel	55,200	55,112	54,900	52,500		54,428
1,600 Diesel			63,900			63,900
1,750 Diesel	69,200					69,200

Source: Portable air compressor manufacturers' price sheets.

THE ENVIRONMENTAL PROTECTION AGENCY

CALCULATION OF QUIETED PORTABLE AIR
COMPRESSOR AVERAGE CURRENT
LIST PRICES

Power Source Type and Air Flow Capacity (cfm) of Predominant Units	Manufacturer Designation					Average List Price
	A	B	C	D	E	
85 Gasoline	\$ 4,150	\$ 4,370		\$ 4,135		\$ 4,218
100 Gasoline			\$ 4,130		\$ 4,675	4,403
125 Gasoline	5,500			5,510		5,505
160 Gasoline	6,000	5,935	5,670	6,020	5,985	5,922
185 Gasoline	6,500	6,545	6,510	6,600		6,539
125 Diesel	6,550				6,750	6,650
160 Diesel	7,000		6,760	7,020		6,927
185 Diesel	7,750		7,610	7,710		7,690
250 Diesel	15,300			14,800	14,595	14,898
365 Diesel	22,300			21,000	21,840	21,713
600 Diesel						
750 Diesel	37,900	36,985	28,100	28,800	29,295	28,732
			33,900	37,850		36,659
900 Diesel	48,800		42,500			45,133
1,050 Diesel		50,925	48,500	44,100		52,658
1,200 Diesel	61,500	61,275	57,500	58,550		60,092
1,600 Diesel			66,800			66,800
1,750 Diesel	89,000					89,000

Source: Portable air compressor manufacturers' price sheets.

THE ENVIRONMENTAL PROTECTION AGENCY
DEVELOPMENT OF ESTIMATES OF AVERAGE LIST
PRICES FOR STANDARD PORTABLE AIR COMPRESSORS BY ENGINE
TYPE AND AIR FLOW CAPACITY CATEGORY (cfm)

Engine Type and (1) Size Categories	Representative Compressor Characteristics		Calculated Average by Air Flow Capacity Category (6)		Major Category (7)		Calculated Average Estimate (8)	
	Capacity (3) (cfm)	List Price (4)	Estimated Share (5) (1972)	Capacity (cfm)	Unit Sales-1972	Percent Share	Capacity (cfm)	List Price
Gasoline Engine Below 251 cfm (A11)	85	\$ 3,835	70% }	90	3,082	39.0% }	132	\$ 4,991
	100	4,083	30					
	125	\$ 5,332	25% }	158	5,683	61.0% }		
	160	5,599	50					
Diesel Engine (2) Below 501 cfm	185	6,201	25					
	125	\$ 6,275	30% }	158	\$ 6,711	78.5% }	195	\$ 8,917
	160	6,527	35					
	185	7,266						
250 - 599 cfm (2)	250	\$12,994	30% }	330	\$16,969	21.5% }		
	365	18,673	70					
Diesel Engine, Above 500 cfm	600	\$26,185	50% }	675	\$29,007	69.8% }	804	\$34,838
	750	31,829	50					
900 and Over cfm	900	\$39,867	35% }	1,102	\$48,316	30.2% }		
	1,050	45,942	25					
	1,200	54,428	30					
	1,600	63,900	7					
	1,750	69,200	3					

Notes: (1) The air flow capacity categories in this column represent the categories used by Kearney for market analysis. They have been grouped into major categories corresponding to the categories developed for study of alternate noise levels by BBN and which correspond to the technical and cost data developed by them. Kearney believes the more detailed air flow capacity categories best reflect competitive product segment grouping of portable air compressors.

(2) No units are manufactured in the air flow capacity range of 451-599 cfm.

(3) Air flow capacity is designed for the most popular selling sizes in each category.

(4) List prices are from Exhibit III-7.

(5) Share reflects the estimated percentage of units which are in each capacity category, giving consideration to the share of units with less popular air flow capacities which are not listed.

(6) Average capacity and list price by air flow capacity category is a weighted average calculated using the representative capacity and list prices and the estimated shares.

(7) Unit sales are from Table III-12. Percent share is the share of the air flow capacity category of total unit sales for the major category.

(8) Average estimates of capacity and list price by major category are a weighted average of the data by air flow capacity category weighted by the percent share of units sold in the major category.

Source: Kearney.

THE ENVIRONMENTAL PROTECTION AGENCY

DEVELOPMENT OF ESTIMATES OF AVERAGE LIST
PRICES FOR QUOTED PORTABLE AIR COMPRESSORS BY ENGINE
TYPE AND AIR FLOW CAPACITY CATEGORY (cfm)

EXHIBIT III-10

Engine Type and Size Categories(1)	Representative Compressor Characteristics			Calculated Average Capacity by Air Flow Category(6)		Major Category(7)		Calculated Average Estimate(8) by Major Category Capacity (cfm)	List Price
	Capacity(3) (cfm)	List Price(4)	Estimated Share(5)	Capacity (cfm)	List Price	Unit Sales-1972	Percent Share		
Gasoline Engine, Below 251 cfm (All)									
75 - 124 cfm	85	\$ 4,218	70%	90	\$ 4,274	3,082	39.0%	132	\$ 5,311
	100	4,403	30						
125 - 250 cfm	125	\$ 5,505	25%	158	\$ 5,972	4,827	61.0%		
	160	5,922	50						
	185	6,539	25						
Diesel Engine, Below 501 cfm(2)									
125 - 249 cfm	125	\$ 6,650	30%	158	\$ 7,111	2,101	78.5%	195	\$ 9,811
	160	6,927	35						
	185	7,690	35						
250 - 599 cfm(2)	250	\$14,898	30%	330	\$19,668	576	21.5%		
	365	21,713	70						
Diesel Engine, Above 500 cfm									
600 - 899 cfm	600	\$28,732	50%	675	\$32,696	1,095	69.8%	804	\$39,231
	750	36,659	50						
900 and Over cfm	900	\$45,131	35%	1,102	\$54,336	473	30.2%		
	1,050	52,658	25						
	1,200	60,092	30						
	1,600	66,800	7						
	1,750	89,000	7						

Notes: (1) The air flow capacity categories in this column represent the categories used by Kearney for market analysis. They have been grouped into major categories corresponding to the categories developed for study of alternate noise levels by BBN and which correspond to the technical and cost data developed by them. Kearney believes the more detailed air flow capacity categories best reflect competitive product segment grouping of portable air compressors.

(2) No units are manufactured in the air flow capacity range of 451-599 cfm.

(3) Air flow capacity is designated for the most popular selling sizes in each category.

(4) List prices are from Exhibit III-8.

(5) Share reflects the estimated percentage of units which are in each capacity category giving consideration to the shares of less popular air flow capacities which are not listed.

(6) Average capacity and list price by air flow capacity category is a weighted average calculated using the representative capacity and list prices and the estimated shares.

(7) Unit sales are from Table III-12. Percent share is the share of the air flow capacity category of total unit sales for the major category.

(8) Average estimates of capacity and list price by major category are a weighted average of the data by air flow capacity category weighted by the percent share of units sold in the major category.

Source: Kearney.

THE ENVIRONMENTAL PROTECTION AGENCY

ADJUSTED ESTIMATE OF AVERAGE LIST
PRICES OF PORTABLE AIR COMPRESSORS
ON THE BASIS OF STANDARD AND
QUIETED UNIT SHIPMENTS

<u>Engine Type and Air Flow Capacity (cfm)</u>	<u>Standard Unit List Price</u>	<u>Quieted Unit List Price</u>	<u>Percent Domestic Shipments of Quieted Units</u>	<u>Weighted List Price (1)</u>
75-124 Gasoline	\$ 3,909	\$ 4,274	20%	\$ 3,982
125-250 Gasoline	5,683	5,972	20	5,741
125-249 Diesel	6,711	7,111	20	6,791
250-599 Diesel	16,969	19,668	20	17,509
600-899 Diesel	29,007	32,696	10	29,376
900 and Over Diesel	48,316	54,336	10	48,918

Note: (1) The weighted list price is derived using the present market share estimates for standard and quieted units. This assumes that the market share for units 600 cfm and below is 80% standard and 20% quieted; and the market share for units 600 cfm and over is 90% standard and 20% quieted.

Source: Table III-7, Exhibit III-9 and III-10.

THE ENVIRONMENTAL PROTECTION AGENCY

ADJUSTED ESTIMATE OF AVERAGE LIST
PRICES OF PORTABLE AIR COMPRESSORS
ON THE BASIS OF STANDARD AND
QUIETED UNIT SHIPMENT

<u>Engine Type and Air Flow Capacity (cfm)</u>	<u>Standard Unit List Price</u>	<u>Quieted Unit List Price</u>	<u>Percent Domestic Shipments of Quieted Units</u>	<u>Weighted List Price(1)</u>
Gasoline Engine, Below 25/cfm (All)	\$ 4,991	\$ 5,311	20%	\$ 5,055
Diesel Engine, Below 501 cfm	8,917	9,811	20	9,096
Diesel Engine, Above 500 cfm	34,838	39,231	10	35,277

Note: (1) The weighted list price is derived using the present market share estimates for standard and quieted units. This assumes that the market share for units 600 cfm and below is 80% standard and 20% quieted; and the market share for units 600 cfm and over is 90% standard and 20% quieted.

Source: Table III-7, Exhibit III-9 and III-10.

EXHIBIT III-12

IV - BASELINE INDUSTRY FORECAST

In order to measure the economic impact of the noise emission levels selected for study, a baseline must be established against which to measure the change. This section presents the baseline forecast of the portable air compressor industry developed for this purpose.

FACTORS INFLUENCING THE BASELINE FORECAST

Historically, sales of portable air compressors have been sensitive to government and private funding of construction activity. Sales of large units have followed trends in the construction industry while smaller units have followed the national economy. Portable air compressor sales have generally lagged behind these indicators by six months to one year.

A substantial portion of the portable air compressors purchased is for maintenance. Therefore, portable air compressor sales are not dependent on the funding of new projects to the same extent as some other types of construction equipment.

Until recently, economists anticipated substantial expansion to occur in public water, sewage and power systems as well as in petroleum and gas production. Growth was also anticipated in the areas of chemical processing, food processing, construction, mining and government. Such growth would stimulate sales

of portable air compressors. However, anticipated energy shortages have caused economists to alter their original projections. Shortages will undoubtedly have an adverse impact on some segments of each of the preceding areas. However, the most adversely affected segments of the economy will not be the primary users of portable air compressors.

The major portion of the federal interstate highway program will be completed by 1978. Other federal, state and local highway programs may be curtailed due to anticipated energy shortages, and the funds may be reallocated. As a result, some decrease in the domestic demand for the large portable air compressors is anticipated. However, large portable air compressors are also used for highway maintenance, and no decrease in highway maintenance is foreseen as a result of anticipated energy shortages.

The anticipated energy shortages could result in a curb on some industrial, commercial and institutional construction. However, construction of water and sewer works, power plants, chemical plants, oil pipelines, petroleum plants and gas plants will not be curtailed but will probably increase. This type of construction accounts for a substantial portion of portable air compressor shipments. Growth in these segments should offset the decline in demand in highway, institutional and commercial construction. Hence, portable air compressor demand in these

markets should remain fairly constant or should slightly increase through 1978.

Demand in the mining industry will increase through 1978 as emphasis is shifted to exploration and mining of energy producing resources. Consumption in the industrial sectors which are the primary users of portable air compressors will increase slightly. Government consumption will remain fairly constant.

BASELINE
FORECAST

Kearney's baseline forecast is based on the important end user market conditions cited in the previous section, information furnished from portable air compressor manufacturers and field survey interviews with manufacturers, distributors and end users. Portable air compressor shipments have remained fairly constant over the past six-year period with cyclical peaks during 1969 and 1972 (see Table III-10). They should stay at about the 1972-1973 level through 1978. Table IV-1, shown on the following page, indicates the baseline forecast developed for 1976, 1977 and 1978. It is formulated as a best point estimate, assuming no federal noise emission standards are adopted.

Table IV-1
Portable Air Compressor Unit
Baseline Forecast(1) (2)

<u>Year</u>	<u>Power Source Type and</u> <u>Air Flow Capacity (cfm)</u>					<u>Total</u>
	<u>Gasoline Engine</u> <u>75-124</u>	<u>125-250</u>	<u>250-599</u>	<u>Diesel Engine</u> <u>600-899</u>	<u>900 and Over</u>	
1976	3,300	4,700	2,400	550	1,800	13,400
1977	3,400	4,700	2,500	570	1,850	13,700
1978	3,500	4,700	2,600	600	1,900	14,000

Notes: (1) Industry respondents are aware of present federal, state and local environmental regulations. They have considered them and are reasonably sure that their market forecasts have adequately reflected their impact.

(2) Anticipated state noise laws and local noise ordinances have been incorporated in the baseline forecast.

This forecast represents a modest increase over 1972 production with a further slight increase from 1976 to 1978. The forecasted levels represent a substantial increase over the 1971 level of shipments.

The groupings BBN used in their selection of alternative noise levels suggested for study and the development of technical and cost data were:

1. Gasoline Engine, Below 251 cfm (All).
2. Diesel Engine, Below 501 cfm.
3. Diesel Engine, Above 500 cfm.

BBN used these categories for technical reasons. To be consistent, it is therefore necessary to consolidate the six categories used for market analysis into the three categories used by BBN. Kearney has therefore used the above three categories in the analysis of economic impact, although we feel strongly that the six categories presented in Table IV-1 would provide a more meaningful analytical base.

Exports and domestic shipments of standard and quieted units must be identified in order to make the correct assessment of economic impact. Table IV-2, on the following page, consolidates the data in Table IV-1 and identifies projected exports and shipments of standard and quieted units.

Table IV-2
Portable Air Compressor Baseline Forecast

	<u>Number of Units Shipped</u>		
	<u>1976</u>	<u>1977</u>	<u>1978</u>
<u>Gasoline Engine, Below 251 cfm (All)</u>			
<u>Domestic Shipments</u>			
Standard	5,760	5,832	5,904
Quieted	1,440	1,458	1,476
Exports	800	810	820
Total Shipments	<u>8,000</u>	<u>8,100</u>	<u>8,200</u>
<u>Diesel Engine, Below 501 cfm</u>			
<u>Domestic Shipments</u>			
Standard	2,124	2,210	2,304
Quieted	531	553	576
Exports	295	307	320
Total Shipments	<u>2,950</u>	<u>3,070</u>	<u>3,200</u>
<u>Diesel Engine, Above 500 cfm</u>			
<u>Domestic Shipments</u>			
Standard	1,985	2,049	2,106
Quieted	220	228	234
Exports	245	253	260
Total Shipments	<u>2,450</u>	<u>2,530</u>	<u>2,600</u>
Grand Total	<u>13,400</u>	<u>13,700</u>	<u>14,000</u>

Source: Exhibits IV-1 and IV-2.

Kearney did not develop a baseline forecast beyond 1978. However, a simple extrapolation of 1972-1978 data to 1980 based on a 2.2% annual increase in unit volume is presented in Exhibits IV-1 and IV-2.

BASELINE FORECAST
CONDITIONS

(a) Market
Conditions

Market characteristics are not expected to change substantially in 1976, 1977 and 1978. The market conditions forecasted

that will prevail during 1976, 1977 and 1978 include:

1. The basic structure of the portable air compressor market will remain unchanged, as outlined schematically in Figure III-1.

2. Basic product applications will not change in the 1976-1978 period.

3. Major industry users and percentage shipments to each industry will remain relatively stable.

4. Dollar volume will increase due to inflation, a customer trend toward more sophisticated and expensive equipment, and the purchase of more costly options and attachments.

5. Product life and ownership cycles are expected to remain substantially unchanged.

6. The number of portable air compressors in use in the field is expected to slightly increase.

7. Exports will remain fairly constant through 1978 at approximately 10% of unit shipments. The export product mix for Canada and Mexico will remain constant and exports to other foreign nations will continue to consist primarily of larger units and the more sophisticated equipment which is not manufactured in those countries.

8. The level of imports will not increase significantly through 1978. The percentage of imports to total unit shipments will remain constant at around 7%.

9. Hydraulic systems will expand their position in this market. However, the percent market penetration gained

by hydraulic systems through 1978 will not be significant. Electric systems will not significantly penetrate this market by 1978.

10. Portable air compressor industry characteristics that will remain relatively unchanged are:

- (a) Number of firms.
- (b) Type of firm.
- (c) Firm size.
- (d) Number of portable air compressor producing plants.
- (e) Product line offering and market shares.
- (f) Production capabilities.
- (g) Financial characteristics.

11. Portable air compressor production costs will not change substantially through the 1976-1978 period after consideration is given to inflation.

12. No major shifts in channels of distribution or change in distributor operations will occur. The quality of distributor organizations will remain fairly constant through this period.

13. Purchasing influences and the factors relating to the purchase of portable air compressors will not change in the 1976-1978 period.

14. All of the four basic methods used to acquire equipment will continue to be used.

15. Portable air compressor leasing will continue to grow and gain a greater share of the dollar volume of portable air compressor sales.

16. Used equipment will continue to be an important factor in the market, but will remain relatively stable.

(b) Forecast
Assumptions

Kearney has made plausible assumptions for major economic conditions. In addition, the analysis of the impact of possible major economic changes associated with particular circumstances is a major study in itself. It cannot be adequately treated within the baseline development of this study. Therefore, the following simplifying assumptions have been made:

1. The Gross National Product will grow at a rate of 4% per year. Observed long-term relationships between economic variables and general historical trends will persist into the future.

2. The present inflation will continue with no major business cycle swings.

3. The present geographical dispersion of population and industry will continue and thereby will continue to augment the demand for construction.

THE ENVIRONMENTAL PROTECTION AGENCY
PORTABLE AIR COMPRESSOR BASELINE FORECAST

	Power Source Type and Air Flow Capacity			Total
	Gasoline Engine Below 251 cfm (All)	Diesel Engine Below 501 cfm	Diesel Engine Above 500 cfm	
<u>1976</u>				
Domestic Shipments (1)	7,200	2,655	2,205	12,060
Export Shipments (2)	800	295	245	1,340
Total Shipments	<u>8,000</u>	<u>2,950</u>	<u>2,450</u>	<u>13,400</u>
<u>1977</u>				
Domestic Shipments (1)	7,290	2,763	2,277	12,330
Export Shipments (2)	810	307	253	1,370
Total Shipments	<u>8,100</u>	<u>3,070</u>	<u>2,530</u>	<u>13,700</u>
<u>1978</u>				
Domestic Shipments (1)	7,380	2,880	2,340	12,600
Export Shipments (2)	820	320	260	1,400
Total Shipments	<u>8,200</u>	<u>3,200</u>	<u>2,600</u>	<u>14,000</u>
Extrapolation to 1979 (3)				
Domestic Shipments	7,542	2,943	2,392	12,877
Export Shipments	838	327	266	1,431
Total Shipments	<u>8,380</u>	<u>3,270</u>	<u>2,658</u>	<u>14,308</u>
Extrapolation to 1980 (3)				
Domestic Shipments	7,708	3,008	2,444	13,160
Export Shipments	857	334	272	1,463
Total Shipments	<u>8,565</u>	<u>3,342</u>	<u>2,716</u>	<u>14,623</u>

Notes: (1) Although it may appear that a discrepancy exists between Kearney's Diesel Engine 250-599 air flow capacity category and the BBN break point at 500 cfm, this is not so, as no units are manufactured in the capacity range of 451-599 cfm.

(2) Kearney estimated that exports will be 10% of total production in the years considered in the forecast (Appendix J).

(3) The 1980 projection is based on a simple extrapolation of 1972-1978 data to 1980 based on a 2.2% annual increase in unit volume.

THE ENVIRONMENTAL PROTECTION AGENCY

BASELINE FORECAST OF DOMESTIC STANDARD
AND QUIETED PORTABLE AIR COMPRESSOR SHIPMENTS, 1976-1978(1)

Year	Power Source Type and Air Flow Capacity						Total
	Gasoline Engine		Diesel Engine				
	Below 251 cfm (All)		Below 501 cfm		Above 500 cfm		
	Standard	Quieted	Standard	Quieted	Standard	Quieted	
1976	5,760	1,440	2,124	531	1,985	220	12,060
1977	5,832	1,458	2,210	553	2,049	228	12,330
1978	5,904	1,476	2,304	576	2,106	234	12,600
1979(2)	6,034	1,508	2,354	589	2,153	239	12,877
1980(2)	6,166	1,542	2,406	602	2,200	244	13,160

Notes: (1) Kearney estimated that the baseline forecast of quieted portable air compressors would be 20% of shipments of gasoline engine, below 251 cfm (all) and diesel engine, below 501 cfm and 10% of shipments of diesel engine, above 500 cfm if no noise emission regulations are anticipated. This is the basis for the calculations used to derive this exhibit.

(2) The 1980 projection is based on a simple extrapolation of 1972-1978 data to 1980 based on a 2.2% annual increase in unit volume.

V - ECONOMIC IMPACT

INTRODUCTION

This section describes the projected economic impacts resulting from the adoption of noise emission standards at the three levels selected for study. Generally, the amount of impact on the portable air compressor market increases directly with the level of quieting achieved and the increasing costs required to attain it.

The analysis in this section first looks at market and total industry impacts. Then the implications of these impacts are correlated with other factors and analyzed to identify specific impacts regarding individual firms or groups of firms. Consideration is given to any further adjustments to the overall impact assessment required by the estimated individual impact conditions.

IMPACT FRAMEWORK

Information obtained from manufacturers, raw material and component suppliers, distributors and contractors, and Kearney analysis has established the probable overall framework for portable air compressor industry/market reaction to adoption of the noise emission levels suggested for study. The elements of the impact framework estimated to result from the adoption of noise standards at Level One, Level Two or Level Three are:

1. The total costs to manufacture the equipment will increase.

2. The manufacturers, within their competitive framework, will pass this cost on in the form of an increase in the distributor price (list price).

3. The distributor will pass its cost increase on in the form of an increase in the negotiated customer price.

4. The portable air compressor end user will pass the increase in his equipment purchase costs on to his customers as an increase in the price of products and services provided. End users will also pass on increased costs in transportation, operations and maintenance, if any.

5. Final changes in industry prices and volumes will reflect the changes in portable air compressor purchase prices and operating costs. These will reflect changed operational practices resulting from new trade-off conditions at the margin. For example, increased maintenance costs may change the economic trade-offs associated with portable air compressor life.

6. Ultimately, the consumer will pay a higher price for products due to the required increased cost to reduce noise. This will be reflected in higher prices paid for the products and services which utilize portable air compressors. If there are overall cost reductions as opposed to cost increases from the adoption of noise control technology, competitive pressures will cause cost decreases to be passed on up the economic chain to the consumer in the form of lower prices.

The scenario under which the economic impacts were estimated is based on the technology and costs provided by the EPA. It is assumed that the technology and costs provided would be the actual future technology adopted and costs incurred. This approach is conservative. It is very possible, if not likely with the passage of time, that new technology at lower costs will be developed. Thus, if the current costs based on an assessment of on-the-shelf technology are reasonably accurate, they are essentially an upper bound estimate. Noise standards can be attained at these costs, but very possibly they will be attained at less cost based on better future technology.

(a) Dynamics

The dynamics associated with the adoption of noise emission standards reflect economic conditions which are somewhat unique. In effect, the portable air compressor end user and the manufacturer know at the time of promulgation what changes will be mandated by the regulation at some point in the future--two or three or possibly even 8 or 10 years away. There is still some uncertainty as to the result that might be expected. For example, technology could fail, the adoption of technology could create unforeseen operating or maintenance problems, or the cost of technology could be very different than that estimated. Under these conditions, however, it is still apparent that adjustment is not based on responding to a short-term or unexpected phenomena. All the participants in the market plan to adjust throughout the period prior to the actual point in time when the regulation is made

effective. Thus, for economic impact purposes the assessment is neither short-term nor long-term. The requirement for adjustment is neither unexpected nor the result of a gradual long-term trend. It is definite and scheduled, and the adjustment response will reflect this.

Kearney's economic impact assessment specifically considers the time range of adjustments. Due to the planning horizon of two years or more from the date of promulgation and the current state of expectations today, it is estimated that the major adjustments required will be made in the first year of enforcement. The adjustment period is expected to extend beyond the first year, but to be of second order significance.

During the first year of enforcement, it is anticipated that old portable air compressors not subject to regulation may very well be extended in life due to the economic advantages which they have over the more costly compressors with noise control. These portable air compressors will be phasing out of the population in future years due to increased maintenance costs as they age physically and accumulate more hours of operation. Also, the impact of local noise ordinances will narrow the range of applications for the unquieted units. Further adjustments will occur in the period beyond one year due to adoption of practices which conserve in the use of portable air compressors in response to the increased costs.

There is also a dynamic problem in reflecting the adjustments which may occur because of rearranging the timing of purchases to avoid as long as possible buying more expensive portable air compressors. The strength of economic incentives for rearranging the timing of purchases will depend on a number of factors. It will be a function of the size of the cost penalty, constraints on sales set by manufacturing capacity, and negative incentives caused by the possible application of local noise ordinances. The latter two factors restrict the amount of pre-buying in relation to what end users may desire solely on the basis of the expected cost increase.

Some end users may replace equipment ahead of the normal cycle in order to purchase at lower prices before the regulation takes effect, thereby gaining one portable air compressor life at the lower price level. In this case, the stock of portable air compressors will be higher before the regulation becomes effective. This will lead to a short-term drop in sales of the more expensive quieted portable air compressors until this "extra" stock is worn out. The higher the cost penalty associated with the noise standard, the greater the incentive for such pre-buying.

Manufacturers of portable air compressors are operating at or near capacity at the present time. Projections of industry unit volume to 1978 do not justify growth in capacity, and no significant industry plans for expansion are known. Manufacturers expect tight supply conditions to prevail through 1978.

Local noise ordinances are expected to mirror federal new product noise standards. They are expected to be adopted in many communities over the next decade. Thus, major pre-buying is unlikely to develop over present sales levels.

Extension of the life of current air compressors and pre-buying both indicate the period of adjustment is likely to last longer than one year. The amount of activity in each case is directly related to the size of the cost penalty incurred. However, the amount of long-run substitution of other technology and changes in industry practices which reduce portable air compressor use also are related to the size of the cost penalty. Since these sets of factors are in offsetting directions, and are estimated to be of second order importance to the adjustments which will be taking place in the first year, it is believed that estimates of first year adjustments are reasonably good order-of-magnitude estimates of the full adjustment process which will occur.

(b) Regulatory Sequence

The size of the changes caused by the enforcement of the regulation in any one given year will tend to directly affect the impact occurring in that year. For example, Kearney's model predicts a much stronger impact for a move from current prices and noise levels directly to a Level Two cost for portable air compressors at 70-73 dBA than a staircase type of sequence in which Level Two is reached after a number of years at Level One.

The impact associated with moving directly to Level Two will be much sharper and create more incentives for pre-buying and other rearrangements to avoid the consequences of the regulation. A sequence of steps of regulation reduces the impact caused by a direct move to a low level standard by spreading it out over a period of time with lower levels of adjustment required at any one point in time.

(c) Important Industry
Considerations

It should be noted that Kearney's analysis indicates:

1. Portable air compressor manufacturers differ significantly with respect to the degree of noise technology sophistication attained. Some manufacturers have a noise engineer on their staff and are currently manufacturing a quieted product. Others have not yet started quieting their equipment. Those firms which have attained a high degree of noise technology and currently have quieted products on the market will be much better prepared to meet the noise emission levels which are set. Their initial costs under the standard should be lower than for those firms which have little or no experience in quieting their products if they maintain their current advantage.

2. The portable air compressor market is price-competitive. Most larger firms have quieting experience. They can be expected to pass any additional cost increases on to their customers in the form of price increases. The prices they set will tend to become industry prices due to the extremely competitive nature of this industry and the market position of these

larger firms. The firms without quieting experience will have to meet the established market price level due to competitive pressures within the lead time provided before enforcement. Cost absorption in the form of lower profit margins on the part of these firms can be expected to take place until their costs are in line.

3. Portable air compressors are a capital good which provide a flow of productive service over a period of years. Thus, first year cost/price increases are only reflected in the portion of portable air compressors in use manufactured that year. End user costs will continue to rise until all the equipment in use (i.e., "the population") is of the "quieted" type.

4. Price increases for products and services in end use markets depend on the significance of portable air compressors in the total production process and the level of cost increases. Costs include the increased price of equipment, expenditures for maintenance, and costs associated with lower productivity from changed performance characteristics. Performance changes are critical since not only the equipment, but the associated operator labor is less productive. Portable air compressor capital and operating costs amount to less than 3% of the total production costs of even intensive use applications. Thus, final consumer product or service price increases resulting from noise abatement will be minor at each level.

5. The purchaser views the price of a portable air compressor as the total price he must pay for the unit ready to operate.

The cost of additional attachments or accessorial features necessary to operate the unit is less than 3%. The cost of pneumatic tools is generally not viewed as a cost associated with a portable air compressor. The only time a purchaser would make such a judgment would be when purchasing a system for the first time or considering a switch to substitute power source system. Such customers represent a negligible portion of total potential customers. Pneumatic tools have a much shorter life cycle than portable air compressors and additional new tools are purchased as applications warrant. Further, a pneumatic tool can be powered by any portable air compressor which can meet the power requirement to run the tool. Therefore, the price increases developed for portable air compressors will be viewed by the customer as the total price increase for the system so long as the tool prices are unaffected.

(d) Level Three
Noise Standards

Level Three is based on a prototype. The costs estimated by BBN are projected using past quieting costs based on current technology. No actual production costs (e.g., cost of material purchased on a quantity basis, direct labor, indirect labor and overhead) are available. Therefore, it was determined that no detailed assessment of economic impact would be made for Level Three. However, the economic impact would be considerably greater than that associated with Levels One and Two for each impact area considered.

(e) Impact Areas

The development of the economic impact assessment has been divided into six segments:

1. Volume Impact. This segment considers the question: What will be the changes in industry unit volume relative to the baseline forecast due to the increased costs from quieting? The change in unit volume is critical to the assessment of the complete impact scenario. It is the key to potential disruptive impacts.

2. Resource Costs. The segment addresses the question: What will be the cost of society's resources used to achieve the noise abatement program for portable air compressors? It reflects estimation of both the increased cost to purchase the noise abated units and the costs associated with performance and maintenance changes caused by the application of quieting technology.

3. Market Impacts. This area considers the question: What broad changes in industry and market conditions will be caused by the adoption of the proposed noise emission standards?

4. Foreign Trade. This segment addresses the question: What impact, if any, will there be on exports, imports and the balance of trade?

5. Individual Impacts. This area considers the question: What impacts are expected to fall differentially on specific companies or industry segments? Will these companies or plants be seriously injured?

6. Disruptive Impacts. This segment addresses the question: What real world economic disruption can be expected to occur from the adoption of the noise standard? It draws the distinction between changes which may occur in an orderly way within the range of adjustments which can be expected and accommodated in a free market system and changes which may cause unemployment, shutdown of plants, and other real world disruptive effects because the adjustments are large and/or the time for adjustment short in relation to today's market conditions and industry capabilities.

VOLUME IMPACT

(a) Purpose

The purpose of this section is to analyze the impact of the noise levels suggested for study on the volume of production of portable air compressors. Volume change is a critical impact since it becomes reflected in other impacts such as production employment, activity in downstream channels of distribution and impacts transmitted to upstream component suppliers.

(b) Pricing

Purchasers of portable air compressors will be presented with a price increase associated with each noise emission level selected for study. Price increases attributable to sound attenuation and compliance and enforcement costs were estimated using the BBN estimated marginal cost of quieting based on list price differentials as presented in Table II-3. The BBN list price was selected as the basis for the economic impact analysis because it is a

conservatively constructed estimate and is based on the broadest sample of cost and noise suppression data available. It is indicative of the upper bound on the expected economic impact.

The cross-checking analyses performed, as discussed in Section II, Appendix A and Appendix B, confirm the conservative nature of the BBN list price analysis results. Also, the conservative assumptions made in incorporating the 2 dBA tolerance further reflect the conservative construction of these estimates. It does not include savings associated with possible economies of full production of quieted portable air compressors. The cost of compliance is low in relation to the list price increases derived from the BBN list price analysis. Considering the low level of compliance cost and the offsetting cost reduction potential of economies from full product of quiet units, these factors can be subsumed validly under the conservative estimates of cost developed by the BBN list price analysis without specifically adjusting the estimates for their inclusion.

The development of average price increases for each power source type and air flow capacity category for portable air compressors for each noise emission level selected for study is presented in Exhibits V-1, V-2 and V-3. These estimates are summarized in Table V-1 on the following page.

Table V-1

Estimated Average List Price
Percentage Increase
by Noise Level and Category

Power Source Type and Air Flow Capacity	Level One		Level Two
	Standard	Quiet	
Gasoline Engine, Below 251 cfm (All)	16.2%	6.1%	33.2%
Diesel Engine, Below 501 cfm	18.4	6.3	47.2
Diesel Engine, Above 500 cfm	14.4	2.9	20.5

Source: Exhibits V-1, V-2 and V-3.

Exhibit V-4 presents the calculation of percentage price increases associated with the adoption of a Level Three standard. The percentage increases range from 32.7% to 100.8%.

(c) Price Elasticity

The dynamics of price reaction to increased portable air compressor prices can be expected to vary depending upon:

1. The extent of price increases.
2. The occurrence of end uses normally requiring power to work on or move material and the potential for meeting needs through alternate means not requiring such power.
3. The ease of substitution of competitive air sources, hydraulic systems, and electric systems (see Appendix E) for portable air compressors. This depends on the technical capability and cost differential between the systems.
4. The ease of achieving greater efficiency of operation and other means of conserving in the use of air compressors

in accomplishing current applications. These can be both technical and institutional.

The price elasticity* of demand is used as a measure of the reaction of the market to a price increase. It relates the change in quantity demanded to the change in price. The estimate of elasticity reflects the total net interaction of the preceding factors impacting on the quantity demanded as prices change from present levels.

The estimates of elasticity developed are based on list prices, giving consideration to the lower transaction prices observed in various segments of the market in recent years.

Information received from portable air compressor manufacturers, distributors and end users indicates that there is a relatively low demand elasticity for price increases under 20%. This is the range of price increases associated with the Level One noise standard studied. The reasons for this are:

1. Portable air compressors presently have a higher degree of acceptance in many applications than competitive systems (other types of air compressors, and hydraulic and electric systems). Price increases of under 20% in many cases will not cause the customer to investigate and purchase competitive systems.

*Mathematically, the price elasticity (η) of demand can be defined as:

$$\eta = \frac{\text{Percentage Change in Quantity Demanded (q)}}{\text{Percentage Change in Price (p)}}$$

$$\eta = \frac{dq/q}{dp/p} = \frac{dq}{dp} \cdot \frac{p}{q}$$

2. Many customers have a high investment in portable power tools. Changing from an air to a hydraulic or electric power source requires investment in tool stock. This can range anywhere from 10% to 200% of the cost of the portable air compressor, depending on end user tool requirements and the size of the portable air compressor purchased by the end user. At a portable air compressor price increase of under 20%, the added cost is a significant barrier to a shift to hydraulic or electric systems.

3. Portable air compressor price increases will provide an incentive to make more efficient use of the stock of portable air compressors. The options available to lengthen the life of portable air compressors presently in use include more effective use of the equipment, improved maintenance, and possible changes in construction practices to reduce the rate of use.

4. The increased price for new equipment will change the new and used equipment trade-offs. The incentive is for extension of the life and more intensive use of used portable air compressors even with increased maintenance costs. This type of substitution is a short-term phenomenon, since the equipment eventually wears out, limiting the opportunity to continue to utilize older equipment.

5. The increase in price of portable air compressors will cause a definite trend toward more renting of equipment.

Intermittent use is frequent in portable air compressor applications. Many customers have an unmistakable intermittent compressor use pattern. They purchase the compressor rather than rent, mainly for the convenience associated with ownership, ease of scheduling, paper work, etc. Some of these customers can be expected to switch to rentals. Rental agencies will purchase more equipment. However, the increased purchases of rental agencies will be more than offset by the decrease in end user purchases.

Estimates of price sensitivity varied, but the industry members considered the demand inelastic. The estimated range of elasticity for all portable air compressors is from -0.2 to -0.5 for a price change of under 20%. The midpoint of this range is -0.35 which is used to develop estimates of the volume impact associated with price increases.

Kearney estimates that the elasticity of demand for portable air compressors is higher for price increases of from 20% to 50%. This range of price increases is associated with the introduction of the Level Two noise standard studied. The reasons are:

1. A 20% to 50% price increase will give potential customers incentive to make a critical comparison of portable air compressor with competitive system application and cost advantages. On the basis of such a comparison, the following is likely to occur:

- (a) In areas where competitive systems offer definite application advantages, a shift will occur due to both application and cost advantages.

- (b) In areas where portable air compressors offer only marginal application advantages, some shift will occur due to cost advantages.
- (c) In many cases at a 20% to 50% price increase, the investment required to change from an air to a hydraulic or electric power source (including the replacement of the entire tool stock) will be less than the investment required to purchase a new quieted portable air compressor.

2. Portable air compressor price increases will result in an incentive to make more efficient use of the stock of portable air compressors.

3. Price increases of 20% to 50% will cause end users to lengthen the life of portable air compressors presently in use. Many end users who normally trade on a cycle will use their present compressor stock until the units are no longer economically serviceable. Many end users can be expected to make an incremental investment in labor and parts to lengthen the life of their present compressor stock.

4. The Level Two price increases will have a definite impact on the new and used equipment trade-offs. More extensive use will be made of used portable air compressors, even with increased maintenance costs. This phenomenon will be short-term since the equipment will eventually wear out, limiting the opportunity to continue to utilize older equipment.

5. The Level Two price increase will cause a substantial increase in equipment rental. Most end users who have a definite intermittent use pattern for portable air compressors

will switch to rentals. Some end users with marginal use patterns will make a new cost analysis which will result in a further shift toward rentals. Most rental agencies presently trade on a cycle and do not have a large investment in maintenance capabilities and compressor parts. Level Two will cause rental agencies to make an incremental investment in maintenance capabilities and parts to lengthen the life of their present compressor stock. On balance, rental agencies will purchase more equipment. However, the increased purchases by rental agencies will be more than offset by decreased end user purchases.

The Level Two price increases are estimated to change the gas/diesel price differential significantly from current levels. The table below presents a comparison of list price increases of gasoline and diesel engine, 125-250 cfm air flow capacity, portable air compressors at Level Two.

Table V-2

Portable Air Compressor Level Two
List Price Increases
by Type of Engine and Air Flow Capacity

<u>Power Source and Air Flow Capacity</u>	<u>Average Standard Unit List Price</u>	<u>Percentage Level Two Price Increase</u>	<u>Adjusted Level Two List Price</u>
Gasoline Engine, 125-250 cfm	\$5,683	33.2%	\$7,570
Diesel Engine, 125-249 cfm	6,711	47.2	9,879

Source: Exhibits III-9 and V-3.

From the table note that Level Two will raise the initial cost differential between the diesel and gasoline engine portable air compressors from approximately \$1,000 to approximately \$3,000. On a ten-year life cycle, this increase in initial cost will offset a portion of the operational and maintenance cost advantages of diesel engine portable air compressors (see Appendix K). Therefore, at Level Two, the trend toward more diesel engine and less gasoline engine portable air compressors in the 125-250 cfm category will be slowed or stopped. This factor has been considered and factored into the Level Two elasticity estimates* for gasoline and diesel engines, below 501 cfm.

In the 20% to 50% price increase range, the demand elasticity for portable air compressors, below 501 cfm will be greater than for those above 500 cfm, primarily based on the following factors:

1. Large portable air compressors are generally used on job sites in remote areas (e.g., federal highway construction projects). Small compressors are generally used on jobs in congested areas, which are usually located near an electric power source. Therefore, stationary air compressors are a possible substitute for portable air compressors in the smaller sizes.

2. Self-propelled air compressors are available and can be substituted for portable air compressors in capacities up to 300 cfm.

*Only 21.5% of the under 501 cfm diesel engines have a capacity of 250 cfm and over. Only a few 250 cfm gasoline engine units are currently produced.

3. Power take-off (PTO) air compressors are available and can be substituted for portable air compressors in capacities up to 250 cfm.

4. Air compressors can easily be truck-mounted in the smaller air flow capacities.

5. Hand held tools powered by the smaller portable air compressors are generally the lighter tools. Electric tools can be substituted for pneumatic tools in many applications requiring light hand held tools.

6. Hydraulic systems are readily available and can be used in many applications where small pneumatic systems are presently used. Hydraulic systems in the smaller capacities are generally price-competitive at current price levels (see Appendix E). The price increases associated with Level Two would give hydraulic systems a substantial cost advantage.

7. Integral pneumatic and hydraulic tools mounted on construction equipment units or special mobile tool carriers have the potential for substitution in the larger air flow capacities.

Estimates of price sensitivity varied, but industry members generally stated that at a 20% to 50% price increase, the elasticity of demand would be much more elastic than for a price increase of under 20%. Industry members agree that demand elasticity for small air flow capacity portable air compressors would be more elastic than for large air flow capacity compressors. The estimated range of elasticity for all gasoline and diesel engine, below 501 cfm compressors is -0.7 to -1.1. The midpoint of this

range is -0.9. The estimated range of elasticity for diesel engine, above 500 cfm portable air compressors is from -0.4 to -0.7, and the midpoint of this range is -0.55. The midpoints of the ranges are used to develop estimates of volume impact.

Table V-3 summarizes the elasticity factors used to develop the estimates of changes in annual volume.

Table V-3

Summary of Demand Elasticity
Midpoint Estimates

<u>Power Source Type and</u> <u>Air Flow Capacity</u>	<u>Amount of Price Increase</u>	
	<u>0% to 20%</u>	<u>20% to 50%</u>
	<u>η (1)</u>	<u>η (1)</u>
Gasoline Engine, Below 251 cfm (All)	-.35	-.90
Diesel Engine, Below 501 cfm	-.35	-.90
Diesel Engine, Above 500 cfm	-.35	-.55

Note: (1) η - Estimated demand price elasticity.

Source: Kearney estimates.

Kearney's portable air compressor analysis indicates that substitution of alternative air sources and hydraulic and electric systems will take place only to a certain point. The air requirement in certain applications must be satisfied through the use of portable air compressors. Furthermore, there are limits to the use of rental and used equipment and the lengthening of equipment life. Therefore, the decrease in new portable air compressor quantity demanded due to price increases will

change at some point. Kearney estimates that this point will be reached when unit demand has decreased to 45% to 50% of the baseline forecast in any given year. At this point demand will become very inelastic since opportunities for substitution, rentals and lengthening of equipment life will be largely exhausted. The diagrammatic presentation shown in Exhibit V-5 clarifies how this point of price insensitivity arises.

(d) Level One

Estimated lead times for an orderly adoption of on-the-shelf quieting technology vary for Level One. BBN recommended a lead time of six months. Lead times estimated by industry indicated 12 to 24 months for model changes. A lead time of one year from the date the regulation is finalized is representative. On this basis, the analysis of Level One economic impact is based on the regulation taking effect January 1, 1976.

Using the BBN list price analysis, estimates of the increased list prices of standard and quieted units associated with the modifications necessary to achieve Level One are presented in Exhibits V-1 and V-2. The calculation of volume impact in all cases is based on the cost of quieting for each category considered. A separate calculation is made for each power source type air flow capacity category and for standard and quieted units.

Volume reductions resulting from price increases associated with the modifications necessary to achieve Level One are estimated based on an elasticity of -0.35. The factors used in the

calculation are summarized in Exhibit V-6. The adjusted baseline forecasts resulting from the adoption of Level One for calendar years 1976-1978 are shown in Exhibit V-7.

Table V-4 below summarizes the estimated Level One reduction in unit volume in 1976.

Table V-4

Level One - Estimated First Year Unit
Reduction from Baseline Forecast, 1976

<u>Power Source Type and Air Flow Capacity</u>	<u>Reduction in Annual Volume</u>	
	<u>Units</u>	<u>Percent</u>
Gasoline Engine, Below 251 cfm (All)	358	4.5%
Diesel Engine, Below 501 cfm	148	5.0
Diesel Engine, Above 500 cfm	<u>101</u>	4.1
Total	<u>607</u>	4.5%

Source: Exhibits IV-1 and V-7.

The total reduction in unit volume resulting from the adoption of the Level One standard ranges from 101 to 358 units depending on type of power source and air flow capacity. The total unit reduction is about 4.5% of baseline production. The largest unit reduction occurs in the category of gasoline engines, below 251 cfm (all). The largest percentage reduction occurs in the category of diesel engines, below 501 cfm. The smallest unit and percentage reduction occurs in the category of diesel engines, above 500 cfm. The Level One reductions do not reduce industry volume below the 1972 shipment level.

(e) Level Two

Estimated lead times for the orderly adoption of on-the-shelf quieting technology vary for Level Two. BBN recommended a lead time of 18 months. Industry sources estimated that longer lead times were required. A lead time of three years from the date the regulation is finalized is representative. On this basis, the analysis of economic impact will be based on the regulation taking effect January 1, 1978.

Using the BBN list price analysis, estimates of the increased list prices associated with the modifications necessary to achieve Level Two are presented in Exhibit V-3. These are derived by subtracting the adjusted list prices in Exhibit V-2 from the adjusted list prices in Exhibit V-3. The estimated elasticities, percent price increases, and decreases in demand used to calculate the Level Two volume impact are presented in Exhibit V-8.

The adjusted baseline forecasts associated with the adoption of Level Two for calendar years 1976-1978 are shown in Exhibit V-9. Table V-5 summarizes the estimated Level Two reduction in unit volume in 1978.

Table V-5

Level Two - Estimated First Year Unit
Reduction from Baseline Forecast, 1978

<u>Power Source Type and Air Flow Capacity</u>	<u>Reduction in Annual Volume</u>	
	<u>Units</u>	<u>Percent</u>
Gasoline Engine, Below 251 cfm (All)	2,100	25.6%
Diesel Engine, Below 501 cfm	1,154	36.0
Diesel Engine, Above 500 cfm	<u>244</u>	9.3
Total	<u>3,498</u>	25.0%

Source: Exhibits IV-2 and V-9.

The total reduction in unit volume resulting from the adoption of a Level Two standard is about 25% and ranges from 244 to 2,100 units, depending on type of power source and air flow capacity. The largest unit reduction occurs in the gasoline engine category, below 251 cfm (all). The largest percentage reduction occurs in the category of diesel engines, below 501 cfm, reflecting the higher cost of meeting a noise standard 3 dBA below the standard for gasoline powered units of the same capacity. The smallest unit and percentage reduction occurs with diesel engines, above 500 cfm. The lower output associated with the introduction of a Level Two standard reduces industry volume well below 1972 shipment levels. The adjusted baseline forecast represents a reduction of about 25% from the average annual volume during the period 1967 to 1972.

(f) Summary

In summary, through using the cost of quieting based on analysis of list price differentials, the reduction in industry volume at Level One is relatively low (607 units). The impact on volume at Level Two is a significant reduction of 3,498 units. As previously noted, the BBN estimated cost of quieting based on analysis of list price differentials represents a conservative estimate (i.e., the price increase per cfm required for quieting is an upper bound estimate). Insofar as the actual cost incurred for quieting is lower, the resulting volume impact on industry sales will be correspondingly lower.

RESOURCE COSTS(a) Purpose

The purpose of this section is to estimate the resources which will be used to meet the noise standard at each level. The resource costs are estimated in three ways:

1. The annual increase in capital cost required by end user industries in the first year of enforcement.
2. The total annual increased costs of the end user industries in the first year of enforcement. Operating cost damages considered included depreciation, cost of capital, transportation costs, operational costs and maintenance costs.
3. The total annual increased costs of operation for a 100% quieted population of portable air compressors based on a future date when nonquieted compressors will have been phased out of the population of compressors in use.

(b) Resource
Cost Factors

The estimates of first year capital costs for end user industries are based on the increased purchase price paid and volume of purchases estimated. The pricing is at the list price level. This measure represents the additional capital which must be financed by end user industries due to the enforcement of the noise standard.

The resource cost factors included in the estimate of the total annual increased costs for end users are:

1. Depreciation. Ten-year, straight-line depreciation of 10% per year is used. Current Internal Revenue Service guidelines allow portable air compressors to be depreciated over a five-year period. However, ten years is generally accepted as average portable air compressor economic life. Therefore, ten years is a better period to use in assessing economic impact.

2. Capital Cost. A return on investment or capital cost rate of 10% of the capital investment is used.

3. Transportation Costs. There will be no increase in transportation costs from manufacturers' plants to the distributor and/or end user location and to and from the job site due to the adoption of Level One noise emission standards. No increase will be incurred because weight increases and size differences still permit shipment at the same minimum truckload rates.

The adoption of Level Two noise emission standards will result in transportation cost increases from manufacturers' plants

to the distributor and/or end user locations. The modifications necessary to attain Level Two will result in the production of a portable air compressor which is larger and weighs more than units presently on the market. As a result, fewer portable air compressors will be shipped per truck, trailer or railroad car. Greater unit weight will also cause an increase in transportation costs in some instances. A detailed description of the calculation of transportation cost increases associated with meeting Level Two noise emission standards appears in Appendix L.

4. Operating Costs. The BBN analysis and industry information indicate that there will be only negligible increases in operating costs. A more detailed explanation of the influence of quieting on operating costs is presented in Appendix M.

5. Maintenance Costs. The BBN analysis and industry information indicate that maintenance cost increases associated with the modifications necessary to attain Level One will be negligible.

Level Two will result in some increased maintenance costs. Industry information indicates that sound suppression items must be added to the compressor which will obstruct the accessibility of the engine and air end. This will result in increasing the cost of portable air compressor engine overhauls. An engine overhaul generally requires 16 man-hours. It is estimated that necessary Level Two modifications will increase the number of required man-hours. Current labor rates run \$15 per man-hour. Only arbitrary estimates of increased time can be made since the additional time fluctuates with unit design and features which are not

known. However, even a significant percentage increase in time would result in only minor annual cost increases.

(c) Upper and Lower
Bound Estimates

Resource cost estimates based on total annual costs for operating portable air compressors and the revised baseline number of units essentially are a lower bound estimate of increased resource costs. This occurs because this estimate considers only the extra cost of using portable air compressors which continue to be used. Substitute products brought into use cost more than the present cost of air systems and this added resource cost (the amount above current air systems costs) is not included in the measure.

An upper bound estimate can be constructed based on the fact that the maximum any set of substitutes could cost is the cost of continued use of portable air compressors at the higher cost level associated with the enforcement of noise standards. This is an upper bound estimate since substitution will occur only when the price of the substitute systems becomes less than the cost of using the new quieted portable units. However, substitutes will be at a higher cost than the original air systems. Insofar as the costs of substitutes decline from improved technology or economies of higher volume, more substitution will occur and the resource costs will approach the lower bound resource cost estimates.

If the capital investment pattern for substitute systems reflects the total cost relationship to air systems, increased capital costs will have a similar lower and upper bound. However, it is

possible that the capital/operating cost relationships of substitute systems vary markedly.

In this section, upper and lower bound estimates of resource costs are developed in order to bracket the range of resource costs incurred from quieting portable air compressors at each level. This is the equivalent of asking the question: What is the annual bill society pays for quiet portable air compressors?

The resource cost estimates for the lower bound consider only costs for air compressors continued to be used. For the upper bound the resource costs are based on the baseline forecast which includes a higher level of cost than the new mix of portable air compressors and substitute systems will cost.

(d) Level One

Increased end user capital cost estimates by power source type and air flow capacity for enforcing a Level One noise standard in 1976 are developed in Exhibits V-10 and V-11. These costs for the first year of enforcement are summarized in Table V-6.

Table V-6

Total Estimated First Year
Increased Capital Costs
for End User Industries -
Level One, 1976

Portable Air Compressor Power Source Type and Air Flow Capacity	<u>Increased Capital Costs(1)</u> ((\$000's))	
	<u>Lower Bound</u>	<u>Upper Bound</u>
Gasoline Engine, Below 251 cfm (All)	\$ 4,839	\$ 5,113
Diesel Engine, Below 501 cfm	3,579	3,809
Diesel Engine, Above 500 cfm	<u>9,681</u>	<u>10,178</u>
Total	<u>\$18,099</u>	<u>\$19,100</u>

Note: (1) Capital costs equal the adjusted forecast volume (lower bound) and baseline forecast (upper bound) multiplied by the increased capital cost per unit.

Source: Exhibits V-10 and V-11.

Note that the total increased capital cost to end user industries is estimated to be in the range of \$18.1 to \$19.1 million for the first year of enforcement. The increased cost is about evenly split between small and large units.

Estimated total annual cost increases in the first year for adoption of a Level One noise standard in 1976 are presented in Exhibits V-12 and V-13. These data are summarized in Table V-7 on the following page.

Table V-7

Total Estimated First Year
Increased Annual Costs
for End User Industries -
Level One, 1976

<u>Portable Air Compressor Power Source Type and Air Flow Capacity</u>	<u>Increased Annual Costs (\$000's)</u>	
	<u>Lower Bound</u>	<u>Upper Bound</u>
Gasoline Engine, Below 251 cfm (All)	\$ 968	\$1,022
Diesel Engine, Below 501 cfm	716	762
Diesel Engine, Above 500 cfm	<u>1,936</u>	<u>2,036</u>
Total	<u>\$3,620</u>	<u>\$3,820</u>

Source: Exhibits V-12 and V-13.

From the data in the table it can be seen that the total estimated increased annual costs for the first year of enforcement are estimated to be in the range of \$3.6 to \$3.8 million. From the two previous tables, note that the relative differences in the first year increased annual costs of operation parallel the relative differences in increased capital costs.

(e) Level Two

Increased end user capital cost estimates in the first year of enforcement for adopting a Level Two noise standard in 1978 are presented in Exhibits V-14 and V-15. These costs are summarized in the table on the following page.

Table V-8

Total Estimated First Year
Increased Capital Costs
for End User Industries -
Level Two, - 1978

<u>Portable Air Compressor Power Source Type and Air Flow Capacity</u>	<u>Increased Capital Costs(1)</u> (\$000's)	
	<u>Lower Bound</u>	<u>Upper Bound</u>
Gasoline Engine, Below 251 cfm (All)	\$ 8,378	\$11,749
Diesel Engine, Below 501 cfm	6,908	11,610
Diesel Engine, Above 500 cfm	<u>13,997</u>	<u>15,718</u>
Total	<u>\$29,283</u>	<u>\$39,077</u>

Note: (1) Capital costs equal the adjusted forecast volume (lower bound) and the baseline forecast (upper Bound) multiplied by the increased capital cost per unit.

Source: Exhibits V-14 and V-15.

The total increased capital cost to end user industries is estimated to be in the range of \$29.3 to \$39.1 million.

Estimated total annual cost increases in the first year of enforcement of a Level Two noise standard in 1978 are presented in Exhibits V-16 and V-17. These data are summarized in Table V-9 on the following page.

Table V-9

Total Estimated First Year
Increased Annual Costs
for End User Industries -
Level Two, 1978

<u>Portable Air Compressor Power Source Type and Air Flow Capacity</u>	<u>Increased Annual Costs</u> (\$000's)	
	<u>Lower Bound</u>	<u>Upper Bound</u>
Gasoline Engine, Below 251 cfm (All)	\$1,723	\$2,416
Diesel Engine, Below 501 cfm	1,411	2,370
Diesel Engine, Above 500 cfm	<u>2,943</u>	<u>3,304</u>
Total	<u>\$6,077</u>	<u>\$8,090</u>

Source: Exhibits V-16 and V-17.

From the data in the table it can be seen that the total estimated increased annual costs for the first year of enforcement are estimated to be in the range of \$6.1 to \$8.1 million. Also from the two previous tables note that the relative differences in the first year increased annual costs of operation parallel the relative differences in increased capital costs.

(f) 100% Quieted
Population

In the long run, all portable air compressors in operation will have been produced, incorporating noise abatement technology. The total annual costs for "quieted" portable air compressors will rise each year until this point is achieved.

In order to develop an order-of-magnitude estimate of what a 100% quieted population of portable air compressors would cost annually, an extrapolation of the 1976-1978 baseline portable

air compressor forecasts was developed to the year 1990. An annual growth rate of 2.2% per year has been utilized. This results in an estimated population of 140,000 portable air compressors in 1990.

A Level One noise standard would result in reducing the estimated 1990 portable air compressor population by about 5%. On this basis, it can be concluded that the Level One total 1990 population will be approximately 133,000 units. A Level Two noise standard would result in reducing the estimated 1990 population by 27.7%. Therefore, the Level Two total 1990 population would be approximately 101,000 units.

Table V-10 summarizes the increased annual operating cost of a 100% quieted population for Levels One and Two.

Table V-10

Total Estimated Annual Increases
in Cost for End User Industries
for a 100% Quieted Population
by Level, 1990

<u>Noise Standard</u>	<u>Increased Annual Cost</u> <u>(\$000's)</u>	
	<u>Lower Bound</u>	<u>Upper Bound</u>
Level One	\$31.5	\$33.3
Level Two	51.2	68.2

Source: Exhibits V-18 and V-19.

Note that:

1. Level One annual increased costs range closely from \$31.5 to \$33.3 million. Level Two cost estimates range more widely from \$51.2 to \$68.2 million.

2. As the required noise emission level is reduced, the cost of quieting increases. Although the total number of units at Level Two is less than at Level One, Level Two costs are increased over Level One by over 100% for the upper bound estimate and slightly over 60% for the lower bound estimate.

(g) Summary

The analysis of the cost of the resources required to quiet portable air compressors indicates that:

1. The capital costs associated with sound attenuation are significant. Total portable air compressor sales were approximately \$90 million in 1972. First year capital costs are projected to be approximately \$18 to \$19 million for Level One and \$29 to \$39 million for Level Two.

2. Operating cost increases will also be significant. For a 100% quieted population, operating costs are projected to be \$32 to \$33 million annually for Level One and \$51 to \$68 million annually for Level Two.

MARKET IMPACT

(a) Purpose

The purpose of this section is to describe additional impacts which are anticipated from the adoption of noise control technology, including both the upstream component suppliers and downstream distributors and end users.

(b) Suppliers

General suppliers to portable air compressor manufacturers

will not be adversely affected by the adoption of noise control technology. The basic reason is that most suppliers to the portable air compressor industry derive only a small portion of their business from the portable air compressor industry. The effects of quieting portable air compressors on the major suppliers that furnish components which contribute to compressor noise are briefly described below:

1. Engine Manufacturers. The major engine manufacturers are large, financially sound companies having strong technical capabilities. Engine quieting will require the investment of substantial capital and personnel resources in development programs aimed at reducing engine noise. Portable air compressor manufacturers are not major purchasers of diesel or gasoline engines. Therefore, engine manufacturers are not expected to make extensive design changes as a result of portable air compressor noise attenuation. Because engine sales volume changes due to the noise emission standards will be relatively small, no substantial changes in engine manufacturer purchasing can be expected to shift to those engine manufacturers which produce the most quiet products.

2. Muffler Manufacturers. A change in the product mix of muffler sales to the portable air compressor industry will occur because more technically sophisticated and higher priced mufflers will be required due to the noise standards. The shift in muffler product mix will not have a significant effect on the muffler industry because portable air compressor manufacturers are not one of the major muffler purchasers.

3. Fan Manufacturers. A redesigned fan may be required to meet the proposed noise emission standards. A change in the product mix of fan sales to the portable air compressor industry could occur because of requirements for more technically sophisticated and higher priced fans. The shift in fan product mix will not have a significant effect on the fan industry because portable air compressor manufacturers are not one of the major fan purchasers.

4. Enclosure and Vibration Isolator Manufacturers. Portable air compressor manufacturers will purchase a much larger quantity of enclosures and isolators. This will have only a moderate effect on these industries as portable air compressor manufacturers will not be a dominant customer.

It is anticipated that most portable air compressor manufacturers will purchase these items from outside suppliers. No severe supply problems are anticipated for engines, mufflers, isolators or fans. Presently industries attempting to comply with OSHA noise requirements and experiencing problems in obtaining shields. Although supply problems due to OSHA requirements are anticipated to be resolved by the 1976-1978 period, EPA noise emission standards will create additional demand and new supply problems could arise.

Other portable air compressor component requirements are not expected to change significantly due to noise emission standards at Level One or Level Two.

(c) Distributors

At Level One, channels of distribution and portable air compressor distributor operations are not expected to materially change due to the noise emission standards. This is primarily because most distributors carry a number of equipment product lines and the compressor sales volume changes due to quieting are relatively small. Some pre-buying immediately before noise regulations take effect may occur as customers attempt to avoid price increases. This will shift the time pattern of distributor sales.

Level Two will not cause channels of distribution to change. However, it will have a greater impact on distributor operations. Many distributors will add other air source lines and competitive systems to their present product lines. The portable air compressor sales mix will change in the lower capacity models, reflecting a shift toward more gasoline engine models. Volume reductions will also occur due to customers using compressors longer and substitution of other systems. Some pre-buying will occur before noise regulations take effect. The lowered distributor volume will be somewhat offset by a higher dollar sales volume for portable air compressors and an increase in compressor rental and leasing. Rental and leasing costs for quieted compressors will rise based on the cost increases associated with quieting.

(d) End Users

Kearney estimates that the increased costs to be incurred by portable air compressor owners at Level One will be less than one-tenth of one percent of total operating costs of end user industries.

Therefore, little if any changes in portable air compressor end user industries are expected at Level Two.

Capital and operational cost increases at Level Two are significant. Some end users having a requirement to work on or move material will purchase alternative air sources or competitive systems. Others will switch to rentals as a method to fulfill their air requirements. There will be a tendency to extend portable air compressor life through preventive maintenance programs.

Smaller end users are more likely to be adversely affected by cost increases than large end users. Generally, large operators are more sophisticated and have better credit ratings, control systems and maintenance programs. Furthermore, large operators can obtain volume discounts on new equipment and replacement parts. Smaller end users generally do not have these advantages and operate with limited capital.

IMPACT ON PORTABLE AIR COMPRESSOR MANUFACTURING OPERATIONS

(a) Purpose

The purpose of this section is to describe additional impacts on portable air compressor manufacturing operations which are anticipated from the adoption of noise standards.

(b) Level One

An industry analysis conducted in conjunction with the Kearney standard cost evaluation indicates that there will be no increases in factor floor space associated with Level One. Minor investments

will have to be made in production equipment.

Employment will decline slightly due to the relatively small decline in sales volume associated with a Level One noise standard. However, this will be offset by the requirement to hire additional personnel to incorporate the modifications necessary in manufacturing portable air compressors to meet Level One.

(c) Level Two

BBN has recommended a strategy to achieve Level Two noise attenuation. These recommendations consist chiefly of listing product modifications which must be made to manufacture a product capable of meeting each standard. They specifically recommend components which a manufacturer should add to the compressor to meet each standard. They do not recommend the engineering and production changes necessary to ensure that component addition will result in quieting. Many manufacturers stated that they currently do not have enough attenuation expertise to predict whether the strategy suggested by BBN will produce the anticipated results. Those that felt the strategy recommended by BBN is feasible indicated that they currently do not know what engineering, production and employment changes will be necessary to ensure the modifications produce the quieting required.

Some adjustments in production operations and factor floor space will be necessary to manufacture a portable air compressor capable of meeting Level Two. Work stations must be increased

incrementally to accommodate storage space for increased component size. If quieting to Level Two requires a larger frame as anticipated by some manufacturers, the size of production lines and individual production stations will have to be increased. The heights of production stations will have to be increased to accommodate taller portable air compressors. More specialized equipment will be required on the production line. Estimates of the necessary increase in factor floor space range from 10% to 50%. More assembly time will be required. Estimates range from 15% to 35%.

A 25.0% decline in unit volume will have a definite impact on employment. Without the modifications necessary for Level Two noise attenuation, the decline in employment would be expected to be proportional. Some offsetting increases in employment will be necessary due to added production functions required for quieting. Since manufacturers presently do not know what engineering changes will be necessary, a quantitative estimate of employment increases cannot be made. However, a general employment forecast can be made as follows.

1. Firms having plants primarily engaged in portable air compressor production will be faced with sizeable layoffs due to reduced unit volume. An order-of-magnitude estimate of the extent of the employment decrease is 10% to 25%.

2. Firms with plants where portable air compressors represent a moderate portion of total production will be able to transfer some production workers to other functions and only

moderate employment decline is anticipated. Some of these plants will be benefitted by increased sales of other air systems or hydraulic systems. An order-of-magnitude estimate of the extent of employment decrease is 5% to 10%.

3. Firms with plants where portable air compressors represent only a small portion of total employment will be able to transfer all affected production workers to other functions and no decline in employment is anticipated.

FOREIGN TRADE

(a) Purpose

This section covers the impact of the adoption of noise standards on export and import patterns for portable air compressors. Noise regulations do not apply to export products, but do apply to products imported for use in the United States.

(b) Exports

Domestic portable air compressor manufacturers will be able to export quieted and unquieted products to foreign countries depending on the competitive requirements of the foreign market with respect to the noise regulations. To the extent that some foreign markets require quiet compressors, domestic manufacturers will be in an improved competitive position since they will have made progress in the application of noise technology to their products under the impetus of noise regulation. The costs associated with Level Two will be high enough that domestic portable air compressor manufacturers will probably have to ship compressors

incorporating at least a portion of the costs associated with noise regulations even though the foreign market competition and regulations in some countries do not require quieted compressors. Since the industry exhibits fairly constant average costs with increased volume, producers can make a diversified product line to meet the varied requirements of foreign markets without incurring extraordinarily higher unit costs. On the other hand, foreign markets which do require portable air compressors quieted to Level Three probably would not provide enough volume to justify meeting Level Three without the impetus of U.S. regulations. Here the regulation will make domestic producers competitive where they would otherwise not have been.

Study inputs from portable air compressor manufacturers indicated that no changes in export patterns were expected due to noise regulations.

(c) Imports

Imports currently account for 5% to 10% of total domestic portable air compressor unit consumption. Imported portable air compressor prices are generally competitive or lower than domestic manufacturers' prices. However, imports have not significantly penetrated the United States portable air compressor market because of lack of effective distribution networks, primarily due to a reputation for poor product quality, poor service and parts delivery, and intensive competition by domestic producers.

BBN made an extensive survey of foreign portable air compressor prices and quieting technology at the request of EPA. BBN identified seven portable air compressor firms that manufacture diesel units which nominally have a 70 dBA noise emission level. These firms are Atlas Copco (Sweden), the Compair Group, consisting of Broomwade, Holman and Maxim (Great Britain), Flottman (Germany), Ingersoll-Rand (Great Britain) and Pokorney (Germany).

At Level One, quieted imported portable air compressors are not expected to make significant inroads into the domestic market. The costs associated with quieting, plus the import costs, would be more than the costs incurred by domestic producers to meet Level One.

At Level Two, the seven firms mentioned could make significant inroads into the domestic market. The extent of their market penetration will depend upon the lead time given to meet the Level Two noise standard and price increase required. Estimates of what constitutes an adequate lead time vary, depending on the source, from two to six years. Estimates of what constitutes a significant price differential vary from 1% to 40%.

These foreign firms each currently produce some models which have noise emission levels at or below Level Two standards. If an adequate lead time is not allowed for domestic producers to engineer and manufacture portable air compressors on a production basis, these foreign manufacturers will be presented a good opportunity to gain an effective distribution system in the United

States. If this occurs and their products sell at a price less than the Level Two domestic product, then their combined order-of-magnitude market penetration could range anywhere from 15% to 40%.

If adequate lead time is given to domestic portable air compressor manufacturers but foreign producers gain a significant price advantage at Level Two, then moderate penetration of the domestic market can be expected. An order-of-magnitude estimate ranges from 10% to 20%.

If an adequate lead time is allowed and domestic manufacturers remain price-competitive at Level Two, no shifts in the domestic/import market share are expected.

(d) Balance of Trade

Based on the factors reviewed above:

1. No material impact on the balance of trade is anticipated from setting Level One.
2. No material impact on the balance of trade is anticipated from setting Level Two if an adequate lead time is given and domestic producers remain cost-competitive.
3. A moderate impact on the balance of trade is anticipated from setting Level Two if adequate lead time is not provided and domestic producers cannot remain price-competitive.

INDIVIDUAL
IMPACTS(a) Purpose

This section addresses differential impacts which may develop, affecting a single firm or set of firms.

(b) Small Portable Air
Compressor Manufacturers

The modifications necessary to meet both Level One and Level Two will require technical expertise in both noise and portable air compressor design engineering since performance has to be maintained as quieting technology is built in. Small manufacturers may not have sufficient manpower and funds to allocate the larger and more costly development programs that will be required. The funds that will be allocated to noise control will be diverted from other product development programs which are vital to maintaining and improving competitive position. In addition, several of these smaller manufacturers have not established ongoing noise control programs such that the specified lead time may not be adequate to comply with impending regulations.

At Level One, costs and quieting technology are expected to create a problem which small manufacturers cannot adjust to with adequate lead time.

At Level Two some of the smaller firms in weaker financial positions will be forced out of the portable air compressor market. Kearney estimates that 50% of the firms with under \$5 million sales, currently operating at a loss or employing less than 100

persons in their portable air compressor operations, are likely to withdraw from the market. These firms collectively account for less than 10% of dollar sales. The exit of half of these companies from the market would not cause a dramatic redistribution of market share. However, it would cause a loss of jobs at the local level in this industry.

(c) Firms Experienced
in Noise Technology

Those firms which have attained a degree of noise technology and currently have quieted products on the market are much better prepared to meet the noise emission levels suggested for study. Their costs should be lower than those firms which have little or no experience in quieting their products. The firms with quieting experience can be expected to pass any additional cost increases on to their customers in the form of price increases. The prices they set will tend to become industry prices due to the competitive nature of this industry. Other manufacturers may have costs for quieting which are significantly higher for a period of time. They will have to meet the established market price level due to competitive pressures. This will give firms experienced in quieting technology an advantage in the market for a limited period.

(d) Development Costs -
Level Two

Several manufacturers expressed concern over the potentially large development costs for Level Two based on their own assessments. If development costs appear too high in relation to volume,

these manufacturers expect to withdraw from some of their low-volume segments of the market and to eliminate some models which have low potential volume and require high developmental costs. The overall impact on manufacturer market shares from these moves would be minor.

DISRUPTIVE IMPACTS

(a) Purpose

This section assesses the potential for disruptive economic impacts due to the establishment of noise standards per se. It concerns "real" world impacts as opposed to impacts which are a change in a forecasted future. With adequate lead time and appropriate planning, business management is able to adjust its plans to reflect changing conditions and avoid adverse impacts on its operations. Through adjustments in planning, future over-capacity, unemployment and other adverse conditions are avoided.

(b) Assessment

The adoption of the noise emission levels suggested for study will have the following probable effects:

1. Level One - 1976. No disruptive impacts are indicated at this level. Cost changes are from 10% to 20%. However, volume changes are minor from baseline conditions. The portable air compressor industry would be expected to continue its normal growth pattern with a Level One noise standard. No unemployment would be anticipated.

2. Level Two - 1978. Adoption of a Level Two standard

will result in higher costs reflected in substantial price increases (33.2%, 47.2%, and 20.5% for gasoline, below 251 cfm; and diesel, above 500 cfm units, respectively). This will result in an overall 27.7% decrease in domestic portable air compressor demand. Portable air compressor production shifts to more gasoline engine compressors will occur in the small capacities. A shift to alternative air sources and competitive systems will occur. Under Level Two, the growth pattern of the portable air compressor industry will be curtailed. Some unemployment can be anticipated. A January 1, 1978 enforcement date for Level Two is considered inadequate lead time by many manufacturers. If this estimate is correct, enforcement of the Level Two time frame is likely to permit foreign manufacturers to establish distribution systems and significantly increase their penetration of the domestic market.

Given the size of the portable air compressor industry, no significant economic disruption to the national or a regional economy will occur from these changes. Some small unemployment (measured in tens) may occur in specific communities.

It should be noted that some manufacturers expressed reservations concerning the practical achievement of the technology/costs/lead times used in the economic impact study for Level Two and most disagreed strongly with Level Three. Adverse impacts could arise if the estimates for these factors utilized are not practically achievable on the bases estimated.

Although disruptive impacts are not anticipated from the adoption of noise standards per se, the impact of noise standards can be cumulative with the impact of other changes affecting the portable air compressor manufacturers. This includes the energy shortage, health and safety regulations, and other production and product regulation programs designed to protect the environment. The timing and cost of these programs could potentially create a significant impact on industry. In effect, too much adjustment can be required and disruption occurs. It is most likely that if disruption occurs, it will not be attributable to one cause such as the noise standards, but will occur because several programs impact the industry in a short period of time with a cumulative effect on costs, volumes of production, and end user activity.

SUMMARY

In this section the economic impact has been assessed based on technical and cost estimates (Section II) provided by EPA through its contract with BBN. A brief summary of the results are:

1. Equipment prices will increase as shown in the table on the following page.

Table V-11Summary of Estimated List Price Increases

<u>Power Source Type and Air Flow Capacity</u>	<u>Percent List Price Increase</u>	
	<u>Level One</u>	<u>Level Two</u>
Gasoline Engine, Below 251 cfm (All)	16.2%	33.2%
Diesel Engine, Below 501 cfm	18.4	47.2
Diesel Engine, Above 500 cfm	14.4	20.5
Average Price Increase	16.3%	33.6%

These price increases will be passed on to end users.

2. Unit volume will be affected as indicated below:

Table V-12Summary of Estimated First Year Unit
Reduction from Baseline forecast

<u>Power Source Type and Air Flow Capacity</u>	<u>Unit Reduction</u>	
	<u>Level One (1976)</u>	<u>Level Two (1978)</u>
Gasoline Engine, Below 251 cfm (All)	358	2,100
Diesel Engine, Below 501 cfm	148	1,154
Diesel Engine, Above 500 cfm	<u>101</u>	<u>244</u>
Total	<u>607</u>	<u>3,498</u>

Level One will result in an overall 4.5% decline in unit volume. Level Two will result in an overall 25.0% decline in unit volume.

3. The cost of noise abatement is as presented on the following page.

Table V-13

Summary of the Resource Costs
Associated with Noise Abatement
(Millions of Dollars)

Noise Standard	First Year of Capital Costs	Enforcement Annual Costs	100% Quieted Population
Level One-1976			
Lower Bound Estimates	\$18.1	\$3.6	\$31.5
Upper Bound Estimates	19.1	3.8	33.3
Level Two-1978			
Lower Bound Estimates	29.3	6.1	51.2
Upper Bound Estimates	39.1	8.1	68.2

The cost of noise attenuation is high in relation to the total 1972 dollar volume of the portable air compressor market of approximately \$90 million.

4. There will be little effect on upstream component suppliers. Distributors and end users will be affected in that alternative air sources and competitive systems will become a more important factor in working on or moving material.

5. There will be no effect on factory operations at Level One. Level Two will require more floor space and assembly time and possibly some production line changes.

6. No unemployment is expected to occur due to Level One. Moderate unemployment in isolated localities will occur if Level Two is adopted.

7. No changes in export patterns will occur because

of noise regulations. Import patterns are not expected to change due to Level One. Imports may significantly penetrate the domestic market with a Level Two if adequate lead times are not established and domestic manufacturers cannot produce a unit which is price-competitive with imported units.

8. If Level Two is adopted, some small manufacturers with weak financial positions are likely to withdraw from the portable air compressor market.

9. There is a potential for disruptive impacts from adoption of a Level Two noise standard. However, no significant impact will be transmitted to the national or regional economy.

THE ENVIRONMENTAL PROTECTION AGENCY

DEVELOPMENT OF ESTIMATES OF PRICE ADJUSTMENTS ASSOCIATED
WITH BRINGING STANDARD UNITS UP TO LEVEL ONE
NOISE EMISSION REQUIREMENTS

<u>Power Source Type and Air Flow Capacity</u>	<u>Capacity (1) cfm</u>	<u>List Price (2)</u>	<u>Price Increase per cfm (3)</u>	<u>Average Price Increase (4)</u>	<u>Adjusted List Price (5)</u>	<u>Percent Price Increase</u>
Gasoline Engine, Below 251 cfm (All)	132	\$ 4,991	\$6.11	\$ 807	\$ 5,798	16.2%
Diesel Engine, Below 501 cfm	195	8,917	8.40	1,638	10,555	18.4
Diesel Engine, Above 500 cfm	804	34,838	6.22	5,001	39,839	14.4

Notes: (1) Capacity is the average air flow capacity estimate for each category derived from Exhibit III-9.

(2) List price is the average list price estimate for each category derived from Exhibit III-9.

(3) The price increase per cfm is the BBN estimate of the increase in list price per cfm which will result from making the adjustments necessary to attain Level One.

(4) The average price increase is the average increase in list price resulting from making the adjustments necessary to attain Level One. This is calculated by multiplying the price increase per cfm by the average capacity listed in the exhibit.

(5) The adjusted list price is the new list price for units meeting the Level One noise emission requirements. This is calculated by adding the average price increase to the list price.

Sources: Exhibits III-7 and III-9; and Bolt Beranek and Newman Inc.

THE ENVIRONMENTAL PROTECTION AGENCY

DEVELOPMENT OF ESTIMATES OF PRICE ADJUSTMENTS ASSOCIATED
WITH BRINGING QUIETED UNITS UP TO LEVEL ONE
NOISE EMISSION REQUIREMENTS

<u>Power Source Type and Air Flow Capacity</u>	<u>Capacity(1) cfm</u>	<u>List Price(2)</u>	<u>Price Increase per cfm(3)</u>	<u>Average Price Increase(4)</u>	<u>Adjusted List Price(5)</u>	<u>Percent Price Increase</u>
Gasoline Engine, Below 251 cfm (All)	132	\$ 5,311	\$2.45	\$ 323	\$ 5,634	6.1%
Diesel Engine, Below 501 cfm	195	9,811	3.19	622	10,433	6.3
Diesel Engine, Above 500 cfm	804	39,231	1.42	1,142	40,373	2.9

Notes: (1) Capacity is the average air flow capacity estimate for each category derived from Exhibit III-10.

(2) List price is the average list price estimate for each category derived from Exhibit III-10.

(3) The price increase per cfm is the BBN estimate of the increase in list price per cfm which will result from making the adjustments necessary to attain Level One.

(4) The average price increase is the average increase in list price resulting from making the adjustments necessary to attain Level One. This is calculated by multiplying the price increase per cfm by the average capacity listed in the exhibit.

(5) The adjusted list price is the new list price for units meeting the Level One noise emission requirements. This is calculated by adding the average price increase to the list price.

Sources: Exhibits III-8 and III-10; and Bolt Beranek and Newman Inc.

THE ENVIRONMENTAL PROTECTION AGENCY

DEVELOPMENT OF ESTIMATES OF PRICE ADJUSTMENTS
ASSOCIATED WITH LEVEL TWO NOISE EMISSION REQUIREMENTS

<u>Power Source Type and Air Flow Capacity</u>	<u>Capacity(1) cfm</u>	<u>List Price(2)</u>	<u>Price Increase per cfm(3)</u>	<u>Average Price Increase(4)</u>	<u>Adjusted List Price(5)</u>	<u>Percent Price Increase(6)</u>	<u>Cumulative Percent Price Increase(7)</u>
Gasoline Engine, Below 251 cfm (All)	132	\$ 5,798	\$ 6.43	\$ 849	\$ 6,647	14.6%	33.2%
Diesel Engine, Below 501 cfm	195	10,555	13.19	2,572	13,127	24.4	47.2
Diesel Engine, Above 500 cfm	804	39,839	2.68	2,155	41,994	5.4	20.5

- Notes: (1) Capacity is the average air flow capacity estimate for each category derived from Exhibit III-9.
- (2) Adjusted Level One list price is the average new list price estimate for each category derived from Exhibit V-1.
- (3) The price increase per cfm is the BBN estimate of the increase in list price per cfm which will result from making the adjustments necessary to attain Level Two.
- (4) The average price increase is the average increase in list price resulting from making the adjustments necessary to attain Level Two. This is calculated by multiplying the price increase per cfm by the average capacity listed in the exhibit.
- (5) The adjusted list price is the new list price for units meeting the Level Two noise emission requirements. This is calculated by adding the average price increase to the list price.
- (6) The percent price increase is the percent price increase associated with the adjustments necessary to bring a Level One unit up to Level Two noise emission requirements.
- (7) The cumulative percent price increase is the percent price increase associated with the adjustments necessary to bring a standard unit up to Level Two noise emission requirements.

Sources: Exhibits III-9 and V-1; and Bolt Beranek and Newman Inc.

EXHIBIT V-3

THE ENVIRONMENTAL PROTECTION AGENCY

DEVELOPMENT OF ESTIMATES OF PRICE ADJUSTMENTS
ASSOCIATED WITH LEVEL THREE NOISE EMISSION REQUIREMENTS

<u>Power Source Type and Air Flow Capacity</u>	<u>Capacity (1) cfm</u>	<u>List Price (2)</u>	<u>Price Increase per cfm (3)</u>	<u>Average Price Increase (4)</u>	<u>Adjusted List Price (5)</u>	<u>Percent Price Increase (6)</u>	<u>Cumulative Percent Price Increase (7)</u>
Gasoline Engine, Below 251 cfm (All)	132	\$ 6,647	\$25.56	\$3,374	\$10,021	50.8%	100.8%
Diesel Engine, Below 501 cfm	195	13,127	23.60	4,602	17,729	35.1	98.8
Diesel Engine, Above 500 cfm	804	41,994	5.28	4,245	46,239	10.1	32.7

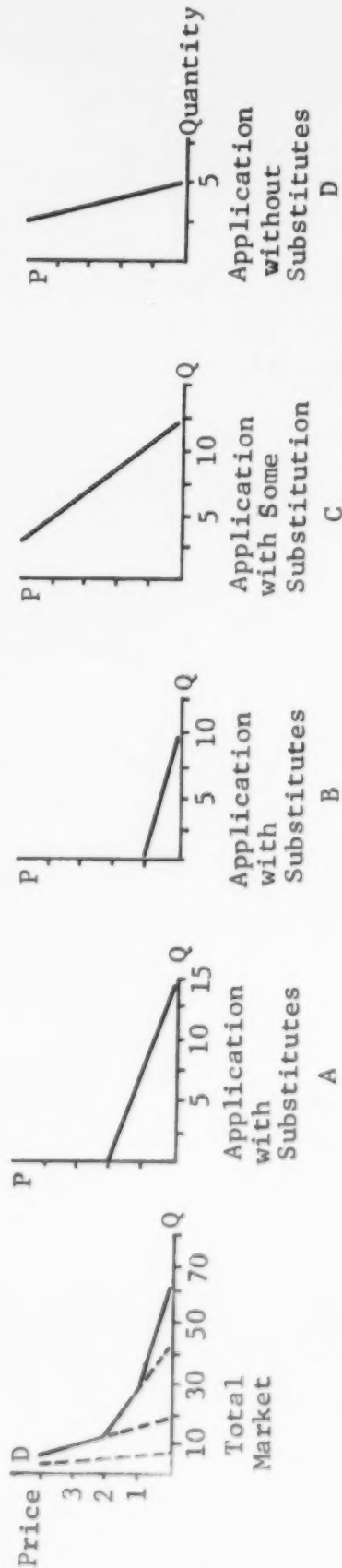
Notes:

- (1) Capacity is the average air flow capacity estimate for each category derived from Exhibit III-9.
- (2) Adjusted Level Two list price is the average new list price estimate for each category derived from Exhibit V-3.
- (3) The price increase per cfm is the BBN estimate of the increase in list price per cfm which will result from making the adjustments necessary to attain Level Three.
- (4) The average price increase is the average increase in list price resulting from making the adjustments necessary to attain Level Three. This is calculated by multiplying the price increase per cfm by the average capacity in the exhibit.
- (5) The adjusted list price is the new list price for units meeting the Level Three noise emission requirements. This is calculated by adding the average price increase to the list price.
- (6) The percent price increase is the percent price increase associated with the adjustments necessary to bring a Level Two unit up to Level Three noise emission requirements.
- (7) The cumulative percent price increase is the percent price increase associated with the adjustments necessary to bring a standard unit up to Level Three noise emission requirements.

THE ENVIRONMENTAL PROTECTION AGENCY

ILLUSTRATION OF THE DEVELOPMENT OF THE RANGE OF INELASTICITY OF DEMAND

The demand for air compressor services can be broken down into component demands for specific applications. Applications where there are more substitutes will be more price-sensitive than those applications where no substitutes exist. Large price increases may eliminate certain applications entirely. Thus, the total quantity demanded is made up of only applications where substitutes are impracticable and the quantity demanded becomes more insensitive to price changes. This is illustrated for a four application case in the simple demand diagrams shown below.



Note that in the range of price 0 to 2, total demand is sensitive to price changes due to applications A and B. However, in the price range above 2, demand is less sensitive because its component applications have less practical substitutes.

THE ENVIRONMENTAL PROTECTION AGENCY

PERCENT VOLUME DECLINE - LEVEL ONE (1)

Power Source Type and Air Flow Capacity	Standard Units			Quieted Units		
	Elasticity	Percent Price Increase	Percent Decrease in Demand	Elasticity	Percent Price Increase	Percent Decrease in Demand
Gasoline Engine, Below 251 cfm (All)	.35	16.2%	5.7%	.35	6.1%	2.1%
Diesel Engine, Below 501 cfm	.35	18.4	6.4	.35	6.3	2.2
Diesel Engine, Above 500 cfm	.35	14.4	5.0	.35	2.9	1.0

Note: (1) The calculation of volume impact in all cases is based on the cost of quieting for each category considered. This includes a separate calculation for each power source type/air flow capacity category and for standard and quieted units.

Sources: Exhibits V-1 and V-2; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY

REVISED BASELINE FORECAST BASED ON THE
VOLUME IMPACT ASSOCIATED WITH LEVEL ONE

	Power Source Type and Air Flow Capacity				Total
	Gasoline Engine		Diesel Engine		
	Below 251 cfm (All)	Below 501 cfm	Above 500 cfm		
1976					
Standard Units	5,432	1,988	1,886	9,306	
Quieted Units	1,410	519	218	2,147	
Total	<u>6,842</u>	<u>2,507</u>	<u>2,104</u>	<u>11,453</u>	
1977					
Standard Units	5,500	2,069	1,947	9,516	
Quieted Units	1,427	541	226	2,194	
Total	<u>6,927</u>	<u>2,610</u>	<u>2,173</u>	<u>11,710</u>	
1978					
Standard Units	5,568	2,157	2,001	9,726	
Quieted Units	1,445	563	232	2,240	
Total	<u>7,013</u>	<u>2,720</u>	<u>2,233</u>	<u>11,966</u>	

Source: Exhibits V-1, V-2, V-6 and IV-2.

THE ENVIRONMENTAL PROTECTION AGENCY

PERCENT VOLUME DECLINE - LEVEL TWO(1)

Power Source Type and Air Flow Capacity	Standard Units			Quieted Units		
	<u>Elasticity</u>	<u>Percent Price Increase</u>	<u>Percent Decrease In Demand</u>	<u>Elasticity</u>	<u>Percent Price Increase</u>	<u>Percent Decrease in Demand</u>
Gasoline Engine, Below 251 cfm (All)	.9	33.2%	29.9%	.9	25.2%	22.7%
Diesel Engine, Below 501 cfm	.9	47.2	42.5	.9	33.8	30.4
Diesel Engine, Above 500 cfm	.55	20.5	11.3	.35	7.0	2.5

Note: (1) The calculation of volume impact in all cases is based on the cost of quieting for each category considered. This includes a separate calculation for each power source type/air flow capacity category and quieted units.

Sources: Exhibits V-2 and V-3; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY
REVISED BASELINE FORECAST BASED ON THE
VOLUME IMPACT ASSOCIATED WITH LEVEL TWO

	Power Source Type and Air Flow Capacity			
	Gasoline Engine		Diesel Engine	
	Below 251 cfm (All)	Below 501 cfm	Above 500 cfm	Total
1976				
Standard Units	4,038	1,221	1,761	7,020
Quieted Units	1,113	370	215	1,698
Total	<u>5,151</u>	<u>1,591</u>	<u>1,976</u>	<u>8,718</u>
1977				
Standard Units	4,088	1,271	1,818	7,177
Quieted Units	1,127	385	222	1,734
Total	<u>5,215</u>	<u>1,656</u>	<u>2,040</u>	<u>8,911</u>
1978				
Standard Units	4,139	1,325	1,868	7,332
Quieted Units	1,141	401	228	1,770
Total	<u>5,280</u>	<u>1,726</u>	<u>2,096</u>	<u>9,102</u>

Source: Exhibits V-2, V-3, V-8 and IV-2.

THE ENVIRONMENTAL PROTECTION AGENCY

LOWER BOUND ESTIMATE OF TOTAL INCREASED CAPITAL COSTS
FOR END USER INDUSTRIES IN THE FIRST YEAR OF ENFORCEMENT - LEVEL ONE
(Thousands of Dollars)

	Power Source Type and Air Flow Capacity				Total
	Gasoline Engine		Diesel Engine		
	Below 251 cfm (All)	Below 501 cfm	Above 500 cfm		
1976					
Standard Units	\$4,384	\$3,256	\$ 9,432	\$17,072	
Quieted Units	455	323	249	1,027	
Total	<u>\$4,839</u>	<u>\$3,579</u>	<u>\$ 9,681</u>	<u>\$18,099</u>	
1977					
Standard Units	\$4,439	\$3,389	\$ 9,737	\$17,565	
Quieted Units	461	337	258	1,056	
Total	<u>\$4,900</u>	<u>\$3,726</u>	<u>\$ 9,995</u>	<u>\$18,621</u>	
1978					
Standard Units	\$4,493	\$3,533	\$10,007	\$18,033	
Quieted Units	467	350	265	1,082	
Total	<u>\$4,960</u>	<u>\$3,883</u>	<u>\$10,272</u>	<u>\$19,115</u>	

Source: Exhibits V-1, V-2 and V-7.

THE ENVIRONMENTAL PROTECTION AGENCY

UPPER BOUND ESTIMATE OF TOTAL INCREASED CAPITAL COSTS FOR END
USER INDUSTRIES IN THE FIRST YEAR OF ENFORCEMENT - LEVEL ONE(1)

(Thousands of Dollars)

	Power Source Type and Air Flow Capacity			
	Gasoline	Diesel Engine		Total
	Engine	Below	Above	
	Below 251	501 cfm	500 cfm	
cfm (All)				
1976				
Standard Units	\$4,648	\$3,479	\$ 9,927	\$18,054
Quieted Units	465	330	251	1,046
Total	<u>\$5,113</u>	<u>\$3,809</u>	<u>\$10,178</u>	<u>\$19,100</u>
1977				
Standard Units	\$4,706	\$3,620	\$10,247	\$18,573
Quieted Units	471	344	260	1,075
Total	<u>\$5,177</u>	<u>\$3,964</u>	<u>\$10,507</u>	<u>\$19,648</u>
1978				
Standard Units	\$4,765	\$3,774	\$10,532	\$19,071
Quieted Units	477	358	267	1,102
Total	<u>\$5,242</u>	<u>\$4,132</u>	<u>\$10,799</u>	<u>\$20,173</u>
1979				
Standard Units	\$4,869	\$3,856	\$10,767	\$19,492
Quieted Units	487	366	273	1,126
Total	<u>\$5,356</u>	<u>\$4,222</u>	<u>\$11,040</u>	<u>\$20,618</u>
1980				
Standard Units	\$4,976	\$3,941	\$11,002	\$19,919
Quieted Units	498	374	279	1,151
Total	<u>\$5,474</u>	<u>\$4,315</u>	<u>\$11,281</u>	<u>\$21,070</u>

Note: (1) The upper bound of increased capital costs is calculated using the average price increases derived from Exhibits V-1 and V-2 and the baseline forecasts derived from Exhibit IV-1.

Source: Exhibits IV-1, V-1 and V-2.

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED LOWER BOUND LEVEL ONE INCREASED ANNUAL TOTAL COSTS
IN THE FIRST YEAR OF ENFORCEMENT⁽¹⁾
(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity	Depre- ciation(2)	Capital Costs(3)	Transportation Costs(4)	Operating Costs(5)	Maintenance Costs(6)	Total
1976	Gasoline Engine, Below 251 cfm (All)	\$ 484	\$ 484	-0-	Negligible	Negligible	\$ 968
	Diesel Engine, Below 501 cfm	358	358	-0-	Negligible	Negligible	716
	Diesel Engine, Above 500 cfm	968	968	-0-	Negligible	Negligible	1,936
	Total	<u>\$1,810</u>	<u>\$1,810</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$1,620</u>
1977	Gasoline Engine, Below 251 cfm (All)	\$ 490	\$ 490	-0-	Negligible	Negligible	\$ 980
	Diesel Engine, Below 501 cfm	373	373	-0-	Negligible	Negligible	746
	Diesel Engine, Above 500 cfm	1,000	1,000	-0-	Negligible	Negligible	2,000
	Total	<u>\$1,863</u>	<u>\$1,863</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$1,726</u>
1978	Gasoline Engine, Below 251 cfm (All)	\$ 496	\$ 496	-0-	Negligible	Negligible	\$ 992
	Diesel Engine, Below 501 cfm	388	388	-0-	Negligible	Negligible	776
	Diesel Engine, Above 500 cfm	1,027	1,027	-0-	Negligible	Negligible	2,054
	Total	<u>\$1,911</u>	<u>\$1,911</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$1,822</u>

- Notes: (1) Annual total costs include depreciation, capital costs, transportation costs, operating costs and maintenance costs.
- (2) Ten-year, straight-line depreciation of 10% per year is used.
- (3) A return on investment or capital cost rate of 10% of the capital investment is used.
- (4) There are no increased transportation costs associated with Level One.
- (5) The BBN analysis and industry information indicate that there will be only negligible increases in operating costs.
- (6) Maintenance costs associated with Level One are projected to be negligible.

Sources: Exhibit V-10; Bolt Beranek and Newman Inc.; industry responses; distributor responses; contractor responses; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED UPPER BOUND LEVEL ONE INCREASED ANNUAL TOTAL COSTS
IN THE FIRST YEAR OF ENFORCEMENT(1)
(Thousands of Dollars)

<u>Year</u>	<u>Power Source Type and Air Flow Capacity</u>	<u>Depre- ciation(2)</u>	<u>Capital Costs(3)</u>	<u>Transportation Costs(4)</u>	<u>Operating Costs(5)</u>	<u>Maintenance Costs(6)</u>	<u>Total</u>
1976	Gasoline Engine, Below 251 cfm (All)	\$ 511	\$ 511	-0-	Negligible	Negligible	\$1,022
	Diesel Engine, Below 501 cfm	381	381	-0-	Negligible	Negligible	762
	Diesel Engine, Above 500 cfm	1,018	1,018	-0-	Negligible	Negligible	2,036
	Total	<u>\$1,910</u>	<u>\$1,910</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$3,820</u>
1977	Gasoline Engine, Below 251 cfm (All)	\$ 518	\$ 518	-0-	Negligible	Negligible	\$1,036
	Diesel Engine, Below 501 cfm	396	396	-0-	Negligible	Negligible	792
	Diesel Engine, Above 500 cfm	1,051	1,051	-0-	Negligible	Negligible	2,102
	Total	<u>\$1,965</u>	<u>\$1,965</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$3,930</u>
1978	Gasoline Engine, Below 251 cfm (All)	\$ 524	\$ 524	-0-	Negligible	Negligible	\$1,048
	Diesel Engine, Below 501 cfm	413	413	-0-	Negligible	Negligible	826
	Diesel Engine, Above 500 cfm	1,080	1,080	-0-	Negligible	Negligible	2,160
	Total	<u>\$2,017</u>	<u>\$2,017</u>	<u>-0-</u>	<u>Negligible</u>	<u>Negligible</u>	<u>\$4,034</u>

- Notes: (1) Annual total costs include depreciation, capital costs, transportation costs, operating costs, and maintenance costs.
- (2) Ten-year, straight-line depreciation of 10% per year is used.
- (3) A return on investment or capital cost rate of 10% of the capital investment is used.
- (4) There are no increased transportation costs associated with Level One.
- (5) The BBN analysis and industry information indicate that there will be only negligible increases in operating costs.
- (6) Maintenance costs associated with Level One are projected to be negligible.

Sources: Exhibit V-11; Bolt Beranek and Newman Inc.; industry responses; distributor responses; contractor responses; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY

LOWER BOUND ESTIMATE OF TOTAL INCREASED CAPITAL COSTS
FOR END USER INDUSTRIES IN THE FIRST YEAR OF ENFORCEMENT - LEVEL TWO
(Thousands of Dollars)

	Power Source Type and Air Flow Capacity				Total
	Gasoline Engine		Diesel Engine		
	Below 251 cfm (All)	Below 501 cfm	Above 500 cfm		
1976					
Standard Units	\$6,687	\$5,140	\$12,602	\$24,429	
Quieted Units	1,487	1,227	594	3,308	
Total	<u>\$8,174</u>	<u>\$6,367</u>	<u>\$13,196</u>	<u>\$27,737</u>	
1977					
Standard Units	\$6,770	\$5,351	\$13,010	\$25,131	
Quieted Units	1,506	1,277	613	3,396	
Total	<u>\$8,276</u>	<u>\$6,628</u>	<u>\$13,623</u>	<u>\$28,527</u>	
1978					
Standard Units	\$6,854	\$5,578	\$13,367	\$25,799	
Quieted Units	1,524	1,330	630	3,484	
Total	<u>\$8,378</u>	<u>\$6,908</u>	<u>\$13,997</u>	<u>\$29,283</u>	

Source: Exhibits V-3, V-8 and V-9.

THE ENVIRONMENTAL PROTECTION AGENCY

UPPER BOUND ESTIMATE OF TOTAL INCREASED CAPITAL COSTS FOR END
 USER INDUSTRIES IN THE FIRST YEAR OF ENFORCEMENT - LEVEL TWO(1)
 (Thousands of Dollars)

	Power Source Type and Air Flow Capacity			
	Gasoline Engine	Diesel Engine		Total
	Below 251 cfm (All)	Below 501 cfm	Above 500 cfm	
1976				
Standard Units	\$ 9,539	\$ 8,942	\$14,205	\$32,686
Quieted Units	1,924	1,761	608	4,293
Total	<u>\$11,463</u>	<u>\$10,703</u>	<u>\$14,813</u>	<u>\$36,979</u>
1977				
Standard Units	\$ 9,658	\$ 9,304	\$14,663	\$33,625
Quieted Units	1,948	1,834	630	4,412
Total	<u>\$11,606</u>	<u>\$11,138</u>	<u>\$15,293</u>	<u>\$38,037</u>
1978				
Standard Units	\$ 9,777	\$ 9,700	\$15,071	\$34,548
Quieted Units	1,972	1,910	647	4,529
Total	<u>\$11,749</u>	<u>\$11,610</u>	<u>\$15,718</u>	<u>\$39,077</u>
1979				
Standard Units	\$ 9,992	\$ 9,910	\$15,407	\$35,309
Quieted Units	2,015	1,953	660	4,628
Total	<u>\$12,007</u>	<u>\$11,863</u>	<u>\$16,067</u>	<u>\$39,937</u>
1980				
Standard Units	\$10,211	\$10,129	\$15,743	\$36,083
Quieted Units	2,060	1,997	674	4,730
Total	<u>\$12,271</u>	<u>\$12,125</u>	<u>\$16,417</u>	<u>\$40,813</u>

Note: (1) The upper bound of increased capital costs is calculated using the average price increases derived from Exhibits V-3 and V-8 and the baseline forecasts derived from Exhibit IV-1.

Source: Exhibits IV-1, V-3 and V-8.

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED LOWER BOUND LEVEL TWO INCREASED ANNUAL TOTAL COSTS
IN THE FIRST YEAR OF ENFORCEMENT (1)
(Thousands of Dollars)

<u>Year</u>	<u>Power Source Type and Air Flow Capacity</u>	<u>Depre- ciation (2)</u>	<u>Capital Costs (3)</u>	<u>Transportation Costs (4)</u>	<u>Operating Costs (5)</u>	<u>Maintenance Costs (6)</u>	<u>Total</u>
1976	Gasoline Engine, Below 251 cfm (All)	\$ 817	\$ 817	\$ 44	Negligible	Minor	\$1,678
	Diesel Engine, Below 501 cfm	637	637	26	Negligible	Minor	1,300
	Diesel Engine, Above 500 cfm	1,320	1,320	135	Negligible	Minor	2,775
	Total	<u>\$2,774</u>	<u>\$2,774</u>	<u>\$205</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$3,742</u>
1977	Gasoline Engine, Below 251 cfm (All)	\$ 828	\$ 828	\$ 45	Negligible	Minor	\$1,701
	Diesel Engine, Below 501 cfm	663	663	27	Negligible	Minor	1,353
	Diesel Engine, Above 500 cfm	1,362	1,362	139	Negligible	Minor	2,863
	Total	<u>\$2,853</u>	<u>\$2,853</u>	<u>\$211</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$3,917</u>
1978	Gasoline Engine, Below 251 cfm (All)	\$ 838	\$ 838	\$ 47	Negligible	Minor	\$1,723
	Diesel Engine, Below 501 cfm	691	691	29	Negligible	Minor	1,411
	Diesel Engine, Above 500 cfm	1,400	1,400	143	Negligible	Minor	2,943
	Total	<u>\$2,929</u>	<u>\$2,929</u>	<u>\$219</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$3,977</u>

Notes: (1) Annual total costs include depreciation, capital costs, transportation costs, operating costs and maintenance costs.

(2) Ten-year straight-line depreciation of 10% per year is used.

(3) A return on investment or capital cost rate of 10% of the capital investment is used.

(4) An explanation of the method used to calculate the increased transportation costs associated with Level Two appears in Appendix L.

(5) The BBN analysis and industry information indicate that there will be only negligible increases in operating costs.

(6) Maintenance cost increases associated with Level Two are projected to be minor.

Sources: Exhibit V-14; Bolt Beranek and Newman Inc.; industry responses; distributor responses; contractor responses; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED UPPER BOUND LEVEL TWO INCREASED ANNUAL TOTAL COSTS
IN THE FIRST YEAR OF ENFORCEMENT(1)
 (Thousands of Dollars)

<u>Year</u>	<u>Power Source Type and Air Flow Capacity</u>	<u>Depreciation(2)</u>	<u>Capital Costs(3)</u>	<u>Transportation Costs(4)</u>	<u>Operating Costs(5)</u>	<u>Maintenance Costs(6)</u>	<u>Total</u>
1976	Gasoline Engine, Below 251 cfm (All)	\$1,146	\$1,146	\$ 62	Negligible	Minor	\$2,354
	Diesel Engine, Below 501 cfm	1,070	1,070	43	Negligible	Minor	2,183
	Diesel Engine, Above 500 cfm	<u>1,481</u>	<u>1,481</u>	<u>151</u>	<u>Negligible</u>	<u>Minor</u>	<u>3,113</u>
	Total	<u>\$3,697</u>	<u>\$3,697</u>	<u>\$256</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$7,650</u>
1977	Gasoline Engine, Below 251 cfm (All)	\$1,161	\$1,161	\$ 63	Negligible	Minor	\$2,385
	Diesel Engine, Below 501 cfm	1,114	1,114	36	Negligible	Minor	2,264
	Diesel Engine, Above 500 cfm	<u>1,529</u>	<u>1,529</u>	<u>155</u>	<u>Negligible</u>	<u>Minor</u>	<u>3,213</u>
	Total	<u>\$3,804</u>	<u>\$3,804</u>	<u>\$254</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$7,862</u>
1978	Gasoline Engine, Below 251 cfm (All)	\$1,175	\$1,175	\$ 66	Negligible	Minor	\$2,416
	Diesel Engine, Below 501 cfm	1,161	1,161	48	Negligible	Minor	2,370
	Diesel Engine, Above 500 cfm	<u>1,572</u>	<u>1,572</u>	<u>160</u>	<u>Negligible</u>	<u>Minor</u>	<u>3,304</u>
	Total	<u>\$3,908</u>	<u>\$3,908</u>	<u>\$274</u>	<u>Negligible</u>	<u>Minor</u>	<u>\$8,090</u>

Notes: (1) Annual total costs include depreciation, capital costs, transportation costs, operating costs, and maintenance costs.

(2) Ten-year, straight-line depreciation of 10% per year is used.

(3) A return on investment or capital cost rate of 10% of the capital investment is used.

(4) An explanation of the method used to calculate the increased transportation costs associated with Level Two appears in Appendix L.

(5) The BBN analysis and industry information indicate that there will be only negligible increases in operating costs.

(6) Maintenance cost increases associated with Level Two are projected to be minor.

Sources: Exhibit V-15; Bolt Beranek and Newman Inc., industry responses; distributor responses; contractor responses; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY
CALCULATION OF THE LOWER BOUND OF ESTIMATED INCREASED
ANNUAL TOTAL COSTS OF LEVEL ONE AND LEVEL TWO 100% QUIETED POPULATIONS

Noise Emission Level(1)	Power Source Type and Air Flow Capacity	Total Increased Operating Cost(2) (\$000's)	Adjusted Baseline Forecast(3)	Increased Operating Costs per Unit(4)	Weight(5)	Projected 1990 Total Population(6)	Operational Costs for a 100% Quieted Population(7) (\$000's)
Level One	Gasoline Engine, Below 251 cfm (All)	\$ 726	6,842	\$ 106	59.7%	79,401	\$ 8,417
	Diesel Engine, Below 501 cfm	537	2,507	214	21.9	29,127	6,233
	Diesel Engine, Above 500 cfm	1,452	2,104	690	18.4	24,472	16,886
	Total	<u>\$2,715</u>	<u>11,453</u>	-	<u>100.0%</u>	<u>133,000</u>	<u>\$31,536</u>
Level Two	Gasoline Engine, Below 251 cfm (All)	\$1,304	5,280	\$ 247	58.0%	58,580	\$14,469
	Diesel Engine, Below 501 cfm	1,066	1,726	618	19.0	19,190	11,859
	Diesel Engine, Above 500 cfm	2,243	2,096	1,070	23.0	23,230	24,856
	Total	<u>\$4,613</u>	<u>9,102</u>	-	<u>100.0%</u>	<u>101,000</u>	<u>\$51,184</u>

- Notes: (1) Calculations are based on Level One taking effect January 1, 1976, and Level Two taking effect January 1, 1977.
- (2) The total increased operating costs are calculated by adding 100% of depreciation, transportation, operating and maintenance costs and 50% of the capital costs in Exhibits V-12 and V-16, respectively.
- (3) As derived from Exhibits V-7 and V-9, respectively.
- (4) Increased operating costs per unit are calculated by dividing the total increased operating costs by the adjusted baseline forecast. Figures have been rounded.
- (5) Weight is the percent of the total adjusted baseline forecast represented by each category.
- (6) The projected 1990 total population in each category is calculated by multiplying the total projected 1990 population as estimated in Section V by the weight.
- (7) The operational costs for a 100% quieted population are calculated by multiplying the increased operating costs per unit by the projected 1990 total population in each category.

Sources: Exhibits V-7, V-9, V-12 and V-16; and Kearney estimates.

THE ENVIRONMENTAL PROTECTION AGENCY

CALCULATION OF THE UPPER BOUND OF ESTIMATED INCREASED
ANNUAL TOTAL COSTS OF LEVEL ONE AND LEVEL TWO 100% QUIETED POPULATIONS

Noise Emission Level(1)	Power Source Type and Air Flow Capacity	Total Increased Operating Cost(2) (\$000's)	Baseline Forecast(3)	Increased Operating Costs per Unit(4)(5)	Weight(6)	Projected 1990 Total Population(7)(8)	Operational Costs for a 100% Quieted Population(9) (\$000's)
Level One	Gasoline Engine, Below 251 cfm (All)	\$ 767	7,200	\$ 107	59.7%	83,580	\$ 8,943
	Diesel Engine, Below 501 cfm	572	2,655	215	22.0	30,800	6,622
	Diesel Engine, Above 500 cfm	1,527	2,205	693	18.3	25,620	17,755
	Total	\$2,866	12,060		100.0%	140,000	\$33,320
Level Two	Gasoline Engine, Below 251 cfm (All)	\$1,829	7,380	\$ 248	58.6	82,040	\$20,346
	Diesel Engine, Below 501 cfm	1,790	2,880	622	22.8	31,920	19,854
	Diesel Engine, Above 500 cfm	2,518	2,340	1,076	18.6	26,040	28,019
	Total	\$6,137	12,600		100.0%	140,000	\$68,219

- Notes: (1) Calculations are based on Level One taking effect January 1, 1976, and Level Two taking effect January 1, 1978.
- (2) The total increased operating costs are calculated by adding 100% of depreciation, transportation, operating and maintenance costs and 50% of the capital costs in Exhibits V-13 and V-17, respectively.
- (3) As derived from Exhibit IV-1.
- (4) Increased operating costs per unit are calculated by dividing the total increased operating costs by the adjusted baseline forecast. Figures have been rounded.
- (5) Discrepancies between increased operating costs per unit in Exhibits V-18 and V-19 are due to rounding.
- (6) Weight is the percent of the total adjusted baseline forecast represented by each category.
- (7) The projected 1990 population under baseline forecast conditions is estimated at 140,000 units.
- (8) The projected 1990 total population in each category is calculated by multiplying the total projected 1990 population of 140,000 by the weight.
- (9) The operational costs for a 100% quieted population are calculated by multiplying the increased operating costs per unit by the projected 1990 total population in each category.

Sources: Exhibits IV-1, V-13 and V-17; and Kearney estimates.

APPENDIX ACAGI COST ESTIMATE
SURVEY RESULTS

At the request of EPA and with the cooperation of the Compressed Air and Gas Institute (CAGI), Kearney conducted a survey of portable air compressor manufacturers to obtain additional industry cost estimates. The estimates developed were to be based on accounting information available for standard and quiet units. These industry cost estimates provide a method by which the cost figures and list price analyses submitted by BBN can be independently cross-checked. It also allows individual firms to indicate why their particular situations might cause significant variations from a norm and create difficulties for their firm to compete.

METHODOLOGY

In order to obtain cost accounting information, Kearney developed forms which CAGI member firms could use to develop and report their costs. These forms also provided a method to determine possible economies resulting from higher production of quieted units. CAGI requested that member firms provide the cost information. A letter of explanation and the forms were sent to all domestic portable air compressor manufacturers. Samples of the forms are shown in Exhibit A-1.

The response by CAGI member firms to this inquiry was not as large as might have been expected nor were the data provided complete in all cases. In total, seven firms submitted information.

A list of those firms reporting is presented in Exhibit A-2. Where possible, the raw data obtained were analyzed. Frequent phone conversations occurred between the responding firms and Kearney for clarification and further information. Follow-up visits were made to some of the firms responding to the inquiry. The purpose of these visits was to perform a review of the cost data submitted and to verify that the results were in accordance with generally accepted industry practice insofar as practicable. The firms visited are indicated in Exhibit A-2.

Because of the confidential nature of the data submitted to Kearney, all assurances have been taken to protect that data. Through the use of averaging techniques and representative numbers, this confidentiality has not been violated in the generation and reporting of numbers used throughout this Appendix.

DATA SOURCES

The type of firm responding to the inquiry (Exhibit A-2) varied in assets, portable air compressor market share and the sophistication of design and production techniques. It should also be noted that these firms represent a diversity in the methods of accounting for their costs.

The seven manufacturers submitting cost data reported on 20 different compressor models. These 20 models reflect both power source types--gasoline and diesel engines. The air flow ratings range from 85 cfm to 1,200 cfm and reflect all three types of air

compression technology--reciprocating, rotary vane and rotary screw. One of these models is not yet in full production.

It should be noted that cost information was only available for examining the costs of achieving noise abatement based on current quiet and standard models. This is approximately equivalent to standard models versus a Level One noise standard. No information was submitted on Levels Two or Three.

The following table shows those categories for which at least one set of costs was received.

Table A-1

Types of Portable Air Compressors
for which Manufacturers' Cost Estimates
to Product Units Complying with Level One
were Received

Engine Power Source	Air Flow Capacity Range (cfm)	Means of Compression		
		Reciprocating	Rotary Screw	Rotary Vane
Gasoline	75-124	x		x
Gasoline	125-250	x	x	x
Diesel	125-249		x	x
Diesel	250-599	x		
Diesel	600-899		x	
Diesel	900 and Over		x	

Source: Kearney.

Sufficient data were not received for any of the categories shown in the preceding table to develop statistically significant average costs. To protect the confidentiality of the data received from the reporting companies as well as to permit direct comparison with the costs developed by BBN, indicative list price

increases will be reported by the engine and capacity categories as used in Table II-3.

VARIANCES IN COST ACCOUNTING SYSTEMS

A cost accounting system normally differentiates three types of costs which are: direct material, direct labor and overhead.

1. Direct Material. In a portable air compressor manufacturing or assembly operation, direct material costs are those costs incurred in obtaining raw material which requires further processing and the purchase of components or subassemblies which, with or without modification, are assembled to produce a finished air compressor.

2. Direct Labor. Direct labor costs are those labor expenses incurred in the processing of raw materials and sub-components or assemblies and actual labor expended in the process of final assembly.

3. Overhead Accounts. Overhead, or burden expense, is not so simply explained. This general category is normally divided into two categories. These are: manufacturing burden expenses, and general, sales and administrative overhead expenses (GS&A). Each of these categories can be further subdivided. Manufacturing overhead is frequently broken out as indirect material and indirect labor. The former relates to those costs incurred in the provision of minor parts such as nuts, bolts, adhesives, etc. The latter typically includes expenses incurred for equipment maintenance, tool crib service and janitorial or

cleanup services, etc. The overhead expenses that are normally found under the category of general sales and administrative expenses would typically include office, supervisory and staff department salaries, staff department costs, advertising expenditures, market research expenditures and salesmen's salaries and expenses.

In many cost accounting systems, overheads or burdens are expressed as rates relative to a particular base or determinant. The manufacturing overhead expense of indirect material is normally represented as a percentage of the direct material costs. Similarly, indirect labor is calculated as a percentage of direct labor expenses. In the case of nonmanufacturing burdens, these are often represented as a percentage of either direct material or direct labor, the sum of these, or the sum of direct labor, direct material and manufacturing burden.

In large corporations of more than one division, those GS&A expenses not solely attributable to a particular division are frequently prorated among the divisions on some basis such as total sales. Because of this institutional effect, an increase in sales causes an increase in the amount of corporate overhead recovered at the division level although corporate overhead costs may have been unaffected by the changes related to the sales increase. Another similar institutional factor is that some costs are often directly related to sales (such as commissions). In many instances, for small changes in price, commission rates will

not be adjusted by companies. This is particularly true in an inflationary period when price increases reflect inflation and salesman incomes are expected to rise with inflation. However, major price increases due to a structural change would not require increased sales compensation in the sense that competitive pressures would require companies to pay salesmen more.

Minor changes occurring within the period covered by a standard cost system are normally handled by variances. These variances are either positive or negative, favorable or unfavorable and are used at the end of the period covered to more accurately represent the costs incurred. The current variances, together with forecasts of production, productivity and any anticipated changes in the price of goods and services, are used by the manufacturer to develop the next period's standardized costs.

In addition to costs for direct material, labor and overhead, a profit margin is built into the final manufacturer's selling price. The distributor then receives a standard margin for his function which is reflected in the manufacturer's recommended list prices. Transaction prices will reflect the negotiation between the end user and distributor, considering such factors as the quantity, delivery, credit terms, and trade-ins.

In order to protect the confidentiality of firms submitting data and to abstract from the complexity of individual cost accounting systems and the variation in production methods,

Kearney has utilized the data obtained to characterize costs and profits into a simple set of elements. These are shown in the table below with representative percentages.

Table A-2
Indicative Portable Air Compressor
Cost and Profit Elements

<u>Element</u>	<u>Cost as a Percent of List Price</u>	
	<u>Representative Percent</u>	<u>Typical Range</u>
Direct Labor and Material	53%	47% - 55%
Margin (includes all overhead and profit)	22	20 - 28
Manufacturer Selling Price	75	70 - 80
Distributor Margin	<u>25</u>	20 - 30
List Price	<u>100%</u>	

Note that the current total "margin" represents a 41.5% mark-up on direct labor and material.

In developing estimates for quieting costs, Kearney utilized the following methodology.

1. Incremental direct labor and material costs are estimated directly from the cost information provided by manufacturers. The detail and amount of information varied considerably and Kearney estimates were used to bridge data gaps where required.

2. Both a "full margin" and an "incremental margin" case are developed. "Full margin" cost reflects applying the same margin rate to the direct labor and material as applies to current standard production. "Incremental margin" cost reflects an

adjustment to the "full margin" data. Full margins include overhead accounts which will not change with the introduction of quieting or will change less than the estimates based on application of "margin dollars" at the same percentage rate as on a standard machine. The "incremental margin" rate estimated by Kearney reflects inclusion of changed costs in overhead accounts and profit margins required to fully include all real incremental costs incurred and profits (cost of capital) on increased investments (i.e., raw material inventories), including direct labor and material costs. The "incremental margin" calculation is designed to leave the company in the same overall economic position as is the case with current production.

3. The distributor margin is set at 25% of list price in all cases. This is representative of distributor margins. It helps to maintain the confidentiality of data since individual companies have specific distributor margin policies built into their list price structure.

The development of the estimates of incremental margin was based on the detailed interaction of Kearney's consultants with the firms providing information. The estimates developed reflect Kearney's best engineering and cost analysis judgments based on the varying levels of information and cooperation provided in each case.

MARGIN DETERMINANTS

It is apparent that list price increases for quieting based

on a "full margin" at the same rate on direct labor and material as on current standard units will overestimate the economic costs in terms of real resources used. This is true because it is self-evident from the changes involved that many overhead accounts will not change significantly and others will change less than in proportion to the changes in direct labor and material. On the other hand, direct labor and material costs themselves would definitely underestimate the real costs incurred. Costs incurred due to apportionment of corporate overheads to a higher sales base are costs to division managements, but are not real costs in an economic sense unless they represent an increased expenditure at the corporate level due to the quieting program.

The paragraphs below describe some of the key considerations Kearney used in developing its estimates of the dollar changes in overhead accounts which in turn are reflected in the "incremental margin" rate estimated.

Burden determinants (the bases used to apportion overhead costs) often differ as a function of the specific expense to be allocated. Therefore, the selection of one determinant to be used to allocate all overhead or burden expenses is somewhat arbitrary. When this one basic value changes appreciably, the burden rate or factor must be recalculated. Examination of the costs listed in Table A-3 indicates that not even all of the controllable costs vary directly as a given single determinant might vary.

Table A-3Partial List of Common Factory
Overhead Expense Categories

<u>Controllable Costs</u>	<u>Uncontrollable Costs</u>
Supplies	Fixed Costs
Water	Rent of machinery
Power	Depreciation - plant
Cutting tools	Depreciation - machinery
Lubricants	
Indirect Labor	Apportioned Costs -
Clerical	from production control
Methods	
Teaching	Apportioned Costs -
Inspection	from building and grounds
Janitorial	
Payroll taxes	
Overtime premium	
Vacation allowance	
Supervision	
Repair and Maintenance	
Scrap	
Source: Kearney.	

Direct labor cost is often selected by manufacturers of portable air compressors as a single determinant used to allocate total burden cost. A representative burden rate would be of the order of 20%-25% of the total direct assembly labor dollars. As much as a 400% increase in direct assembly labor dollars is estimated by some manufacturers for quieting. It would be totally unrealistic in such cases to assume that applicable overhead expenses would increase in direct proportion due solely to quieting current models.

Inventory investment will increase with the quieting program so that additional funds must be provided to pay the cost of capital on this increased element of investment.

ECONOMIES OF FULL PRODUCTION

In developing estimates of the cost for quieting, consideration was given to identifying and incorporating any economies which may result from a much higher rate of production of quiet models. Definite economies were identified. These typically ranged up to 5% of present increased direct labor and materials used on quiet models.

LIST PRICE INCREASES AT "FULL MARGIN"

For purposes of comparison "full margin" list price increases are calculated and presented. The "full margin" cost evaluation is based on obtaining actual increases in direct material purchased and actual increases in the direct labor of fabrication and assembly. It allocates "full margin" or overhead to a quieted unit in addition to the changes in direct costs at the same rate as on current standard models. The following table depicts indicative costs for the case where each manufacturer's total production is of units similar to his currently available quiet models.

Table A-4

Current Indicative Full Margin List Price
Increases Based on Data Supplied by
Portable Air Compressor Manufacturers

<u>Engine/Air Flow Capacity Category</u>	<u>Incremental List Price Increases</u>			
	<u>Total \$(1)</u>	<u>\$ per cfm</u>	<u>\$ per dBA</u>	<u>\$ per cfm per dBA</u>
Gasoline Engine, Below 251 cfm (All)	\$ 565.25	\$4.10	\$ 56.25	\$0.41
Diesel Engine, Below 501 cfm	1,435.20	5.98	123.50	0.51
Diesel Engine, Above 500 cfm	8,626.00	9.08	504.00	0.53

Note: (1) The above totals are based on the actual average capacities developed from submitted data. If the industry averages (based on total unit sales as shown in Exhibit III-9) were used, the total list price increases would be \$541.20, \$1,166.10 and \$7,300.30, respectively.

Source: Kearney estimates.

These increases do not reflect the total list price increases resulting from the manufacture of units meeting the suggested Level One sound pressure levels. More than 65% of the models used in developing the above table will not meet the suggested "not to exceed" criteria with a manufacturing tolerance of 2 dBA. That is, the average sound pressure levels of most of these units plus the 2 dBA manufacturing tolerance is greater than the "not to exceed" criteria. Reducing the current sound levels to an average of 76 dBA for all diesel units with capacities greater than 500 cfm, and an average of 74 dBA for all other units, provides a 2 dBA tolerance between the Level One average and the "not to exceed"

sound levels. The results of appropriately pricing these further sound reductions are shown in Table A-5.

Table A-5

Indicative Full Burden List Price
Increases to Achieve Sound Levels
Suggested with a 2 dBA Tolerance

<u>Engine/Air Flow Capacity Category</u>	<u>List Price Increases</u>	
	<u>Total \$(1)</u>	<u>\$/cfm</u>
Gasoline Engine, Below 251 cfm (All)	\$ 659.00	\$4.78
Diesel Engine, Below 501 cfm	1,632.00	6.80
Diesel Engine, Above 500 cfm	8,949.00	9.42

Note: (1) The above totals are based on the actual average capacities developed from submitted data. If the industry averages (based on total unit sales as shown in Exhibit III-9) were used, the total list price increases would be \$631.00, \$1,326.00 and \$7,574.00, respectively.

Source: Kearney estimates.

It must be emphasized that the increases in Tables A-4 and A-5 are representative only of the data submitted. Because of the insufficiency of data, no statistical significance can be ascribed to any of these values.

The estimation of list price increases at full margin can be expected to overstate the actual economic change by a significant percentage. Therefore, full burden rates as currently applied cannot be used without modification.

LIST PRICE INCREASES
AT INCREMENTAL MARGIN

The "incremental margin" cost evaluation used the actual

direct material and direct labor costs as reported by the participating CAGI members. Kearney's estimate of "incremental margin" is at a rate of 9%-10% of direct costs, i.e., direct material and direct labor. This is equivalent to an "incremental margin" of approximately 7% to 8% of the list price versus a full margin of 22% of the list price as shown in Table A-2. The percentages are the result of the analysis which directly considered the cost changes in overhead accounts. Using "incremental" percentages, Kearney developed the "incremental margin" dollars attributable to meeting the suggested Level One sound pressure criteria. Accounting for margins in this manner prevents the over-recovery of the actual overhead dollars spent that would result if full margin rates were applied. The full margin rate reflects many cost items which do not change as a direct result of quieting current models. Many of these items are time-related. That is, they vary directly with the passage of time but not with the cost of the units manufactured. Other burden expenses vary more directly with the number of units produced than with their cost.

List price increases were developed which permit individual firms to maintain their current level of profitability. It was assumed that, on the average, no major investments in plant or equipment would be required to produce units complying with the suggested Level One sound characteristics. Total investment would, however, increase due to the increased value of inventories. The incremental increase in the value of inventories reflects not

only the increased direct material costs but increases in the use of indirect material as well.

The following table depicts indicative costs for the case where each manufacturer's total production is of units similar to his currently available quieted models.

Table A-6

Current Indicative Incremental List Price
Increases Based on Data Supplied by
Portable Air Compressor Manufacturers

<u>Engine/Air Flow Capacity Category</u>	<u>Total \$(1)</u>	<u>\$ per cfm</u>	<u>\$ per dBA Reduced</u>	<u>\$ per cfm per dBA</u>
Gasoline Engine, Below 251 cfm (All)	\$ 372.00	\$2.75	\$ 37.05	\$0.27
Diesel Engine, Below 501 cfm	598.50	2.50	51.50	0.21
Diesel Engine, Above 500 cfm	5,810.25	6.40	339.60	0.38

Note: (1) The above totals are based on the actual average capacities developed from submitted data. If the industry averages (based on total unit sales as shown in Exhibit III-9) were used, the total list price increases would be \$363.00, \$487.50, and \$5,145.60, respectively.

Source: Kearney estimates.

These increases do not reflect the total list price increases resulting from the manufacture of units meeting the suggested Level One sound pressure levels. More than 65% of the models used in developing the above table will not meet the suggested "not to exceed" criteria with a manufacturing tolerance of 2 dBA. That is, the average sound pressure levels of most of these units plus the 2 dBA manufacturing tolerance is greater than the "not to exceed"

criteria. Reducing the current sound levels to an average of 75 dBA for all diesel units with capacities greater than 500 cfm, and an average of 74 dBA for all other units, provides a 2 dBA tolerance between the Level One average and the "not to exceed" sound levels. The results of appropriately pricing these further sound reductions are shown in Table A-7.

Table A-7

Indicative Incremental List Price
Increases to Achieve Sound Levels
Suggested with a 2 dBA Tolerance

<u>Engine/Air Flow Capacity Category</u>	<u>Incremental List Price Increases</u>	
	<u>Total \$(1)</u>	<u>\$/cfm</u>
Gasoline Engine, Below 251 cfm (All)	\$ 417.00	\$3.10
Diesel Engine, Below 501 cfm	658.50	2.75
Diesel Engine, Above 500 cfm	6,013.75	6.65

Note: (1) The above totals are based on the actual average capacities developed from submitted data. If the industry averages (based on total unit sales as shown in Exhibit III-9) were used, the total list price increases would be \$409.20, \$536.25 and \$5,346.60, respectively.

Source: Kearney estimates.

It must again be emphasized that the increases in Tables A-6 and A-7 are representative only of the data submitted. Because of the insufficiency of data, no statistical significance can be ascribed to any of these values.

ANALYSIS OF COST DATA

List price changes were compared for 19 different models. In approximately 65% of these cases, the b3N list price based estimates exceed those based on "full margin." In approximately

10% of the sample, "full margin" list price changes exceed those based on the list price analysis but the differences are not significant. Of the five remaining cases, where "full margin" changes exceed the list price based changes, four relate to units that the manufacturers believe would be able to comply with suggested Level Two sound characteristics with minor modifications and therefore a low concomitant price change. The fifth unit does not yet meet suggested Level One criteria.

Table A-8 presents a comparison of the estimates of the cost of quieting based on five measures for the 19 production models for which costs were developed based on submitted cost data:

1. Actual Model List Price Increases.
2. BBN estimate of List Price Increases without Tolerance Based on Analysis of List Price Differences (see Section II).
3. BBN Estimate of List Price Increases with a 2 dBA Tolerance (see Section II).
4. Kearney's "Full Margin" Estimate of List Price Increases.
5. Kearney's "Incremental Margin" Estimate of List Price Increases.

Table A-8

Comparison of an Index of Actual
List Prices and BBN and Kearney List Price Estimates

<u>Case</u>	<u>Quiet Minus Standard List Price Difference</u>	<u>BBN Estimates Based on List Price Analysis</u>		<u>Kearney Estimates Based on Submitted Costs</u>	
		<u>without Tolerance</u>	<u>with Tolerance</u>	<u>Full Margin</u>	<u>Incremental Margin</u>
1(2)	100	288	388	99	78
2(1)	100	248	287	100	78
3(1)	100	237	315	112	88
4(2)	100	182	268	101	34
5(2)	100	256	377	157	123
6(3)	100	217	251	112	87
7(1)	100	208	305	143	112
8(2)	100	175	202	99	77
9(2)	100	171	197	129	101
10(2)	100	102	138	98	24
11(2)	100	154	226	161	126
12(2)	100	112	165	137	53
13(2)	100	74	100	101	35
14(2)	100	118	173	177	148
15(2)	100	219	323	345	245
16(3)	100	67	78	108	91
17(1)	100	105	121	304	216
18(1)	100	72	83	219	155
19(1)	100	113	131	390	276

- Notes: (1) This unit currently meets the "not to exceed" suggested Level One sound pressure level with the 2 dBA tolerance.
- (2) This unit currently meets the "not to exceed" suggested Level One sound pressure level but will not meet it with the 2 dBA tolerance.
- (3) This unit currently does not meet the "not to exceed" suggested Level One sound pressure level.

Source: Kearney estimates.

In order to assure confidentiality, the company and air flow rating are not identified and the data are presented based on an index set at 100 for the actual list price difference.

Note that:

1. The "full margin" estimates are above the actual list increases in 15 of the cases. This would be expected since competition in the marketplace would not be expected to allow for recovery of large amounts above the actual incremental costs incurred.

2. The "incremental margin" estimates are below the actual list price increases in many cases and are below the BBN estimates with the tolerance in most cases. The estimates are much closer for units in the diesel, 501 cfm and above category.

3. Four "incremental margin" data points exceed the BBN and actual list price estimates. Discussion with these firms indicates their belief that their models, with minor modifications and therefore small cost increases, are capable of achieving Level Two sound characteristics. Therefore, that part of this difference is attributable to costs associated with a Level Two rather than Level One standard.

SUMMARY LIST
PRICE COMPARISON

A summary comparison of the list price increases associated with the BBN list price analyses and the list price increases at full and incremental margin based on costs provided by CAGI members is presented in Table A-9 on the following page.

The BBN list price estimates without tolerance in the table are based on analysis of actual list price differences between

Table A-9
Comparison of Quieting List Price
Increases to Meet a Level One Standard (1)

Power Source Type and Air Flow Capacity	Kearney Indicative List Price Increases		Incremental Margin		BBN List Price		Range of Difference (3)
	without Tolerance (2)	with Tolerance (2)	without Tolerance (2)	with Tolerance (2)	without Tolerance (2)	with Tolerance (2)	
Gasoline Engine Below 251 cfm (A11)	4.10	4.78	2.75	3.10	4.15	6.11	\$1.33 to \$3.36
Diesel Engine, Below 501 cfm	5.98	6.80	2.50	2.75	6.23	8.40	1.60 to 5.90
Diesel Engine, Above 500 cfm	9.08 (4)	9.42 (4)	6.40 (4)	6.65 (4)	5.38	6.22	-.18 to -3.20

Notes: (1) This comparison is made on the basis of costs provided by CAGI members to bring selected units down to their present noise emission levels and the average net cost per cfm to bring all standard units down to the noise emission levels suggested for study based on the BBN list price analysis.

(2) Tolerance is the 2 dBA tolerance between the Level One average and the "not to exceed" sound levels.

(3) Range of difference is the range of difference between list price increases based on the BBN list price analysis and the list price increases based on costs provided by CAGI members.

(4) Includes costs for several machines which are thought to be able to meet a Level Two standard with very little additional cost based on the current noise abatement features engineered into the unit.

Sources: Bolt Beranek and Newman Inc.; and Kearney.

standard and quiet models of manufacturers for a total sample of 196 machines. The BBN estimates including a 2 dBA tolerance provide for additional price increases beyond the current list price differences to build in the costs of 2 dBA tolerance needed to meet a "not to exceed" noise standard.

The data in the table show that:

1. List price increases associated with the BBN list price analysis are higher for the gasoline engine and diesel engine, below 501 cfm categories than those associated with price increases based on costs provided by CAGI members. For diesel engine units above 501 cfm air flow capacity, the BBN estimates are of the same order of magnitude as the "incremental margin" estimates.
2. The list price increases based on costs provided by CAGI members are higher under "full margin" conditions than under "incremental margin" conditions. Kearney believes the latter concept more accurately reflects the real cost (and thus price increases) which will be incurred.
3. The list price increases based on costs provided by CAGI members imply that costs to quiet gasoline units and small diesel units of the same approximate capacities will be about the same under the "incremental margin" estimates. Cost to quiet the large diesel units will be substantially higher per cfm. The BBN list price analysis implies that the costs to quiet small diesel units will be higher than the costs to quiet gasoline units of the same approximate capacities.

SUMMARY

The cost data developed in this Appendix from industry accounting data have been used to develop "indicative" or "representative" costs of quieting. These estimates are based on a small sample of data (19 units). The extent of the cost information provided varied, as some manufacturers were unwilling to provide data which they felt were too sensitive and confidential. Kearney bridged data gaps based on the best information it had available. The results are not sufficiently reliable to merit replacing the larger sample BBN list price analysis. The results do, however, provide a useful cross-check which indicates that price increase estimates based on the BBN analysis including the 2 dBA tolerance are conservative estimates, particularly in the lower air flow capacity ranges.

Examination of the data developed indicates that no disproportionate incremental cost disadvantage accrues to smaller firms as a result of manufacturing air compressors that meet the suggested Level One. This result is not unreasonable in that the incremental increases do not anticipate major capital expenditures for plant or equipment. Most plants indicate that no plant size increases are needed for Level One. A few indicate minor increases of the order of 1% or 2%.

The cost data discussed in this Appendix reflect representative incremental list price increases to achieve Level One only. Many firms indicate that Level Two cannot be achieved without

appreciable research and development effort as well as redesign and engineering. No estimates are currently available for the costs of these activities. If, as a result of redesign and engineering, different tooling is required from that needed to manufacture units complying with Level One, appropriate overhead rates must be developed to reflect amortization of this equipment.

THE ENVIRONMENTAL PROTECTION AGENCY

INSTRUCTION SHEET FOR
THE COMPONENTS COST TABLE

- Unit Designation: 1) Fill in cfm.
2) Check whether gasoline or diesel powered.
3) Check the type of production run. Complete one table for each type of run.

For Each Component

- Column I : Enter the number required per unit manufactured.
- Column II : Enter period, (please specify), volume, i.e., the total number of components manufactured.
- Column III: Enter the current total cost per unit manufactured, e.g., if eight isolators, (the value in Column I) are required per manufactured unit, and each isolator costs \$1.00, then the value entered in Column III is \$8.00.
- Column IV : Enter period, (please specify), volume, i.e., the total number of components purchased.
- Column V : Enter the current total cost per unit manufactured. See Column III for example.
- Column VI : Enter period, (please specify), volume, i.e., the total number of components transferred intrafirm.
- Column VII: Enter the current total cost per unit manufactured. See Column III for example.

If your unit requires additional components not listed, please list these under the "Other" heading and complete Columns I through VII for each.

Again, please specify the period for which volume figures are reported in Columns II, IV and VI.

COMPONENTS COST TABLE
(See attached instruction sheet)

FORM 1

Model Number: _____

☐ Gasoline

☐ Current Standard

Unit Designation: _____ cfm

☐ Diesel

☐ Current Quiet

☐ Full Production
Quiet

Company: _____

Location: _____

Component	Component Cost per Unit Sold by Method of Acquisition						
	No. per Unit	Manufacture		Purchase		Transfer	
	Col. I	Volume Col. II	Component Cost (\$) Col. III	Volume Col. IV	Component Cost (\$) Col. V	Volume Col. VI	Component Cost (\$) Col. VII
Engine							
Compressor							
Air Receiver							
Hood							
Running Gear							
Radiator							
Mufflers							
Fan							
Air Cleaners							
Isolators							
Adequate Enclosures							
Sound Insulation							
Extensive Enclosures							
Other (please specify)							
1. _____							
2. _____							

INSTRUCTION SHEET FOR THE
ASSEMBLY STATION DESCRIPTION SHEET

- Unit Designation:
1. Fill in cfm.
 2. Check whether gasoline or diesel powered.
 3. Check the type of production run. Complete one table for each type of run.

List each station by its designation and for each station provide the following information:

Column I : List the components assembled at that station.

Column II : List the components tested or inspected at that station.

Column III: List any other operations that are performed at that station.

FORM 2

ASSEMBLY STATION DESCRIPTION SHEET
(See attached instruction sheet)

Model Number: _____ ☐ Gasoline ☐ Current Standard

Unit Designation: _____ cfm ☐ Diesel ☐ Current Quiet

☐ Full Production
Quiet

Company: _____

Location: _____

Station Number	Components Assembled Col. I	Components Tested Col. II	Other Operations Col. III

INSTRUCTION SHEET FOR
THE ASSEMBLY COST TABLE

- Unit Designation:
1. Fill in cfm.
 2. Check whether gasoline or diesel powered.
 3. Check the type of production run. Complete one table for each type of run.

For Each Station

- Column I : Enter the total current costs of all components assembled at that station.
- Column II : Enter the current costs of the direct labor manning the station.
- Column III: Enter the current total costs of all indirect materials used at that station.
- Column IV : Enter the current costs for indirect labor allocated to that station.
- Column V : Enter the current allocation of appropriate assembly overhead expenses, (e.g., light, heat, taxes, insurance, etc.).
- Totals: Total each column.
- Total Assembled Cost/Unit: This figure is the sum of the five column totals.

Company Level Allocations/Unit: This figure should reflect the allocation per unit of all company level overhead expenses, (e.g., General and Administrative, Selling, Advertising, etc.). It should also include per unit profit. (Note: The sum of "Total Assembled Cost Unit" plus "Company Level Allocations/Unit" should equal the average unit sale price, i.e., List Price less average dealer discount.)

Note: Overhead expense solely applicable to the manufacturing function should be included in the manufacturing costs reported on the Components Cost Table.

FORM 3

ASSEMBLY COST TABLE
(See attached instruction sheet)

Model Number: _____ ☐ Gasoline ☐ Current Standard
Unit Designation: _____ cfm ☐ Diesel ☐ Current Quiet
☐ Full Production Quiet

Company: _____

Location: _____

Station	Assembly Costs per Unit Sold				
	Direct Material (\$) Col. I	Direct Labor (\$) Col. II	Indirect Material (\$) Col. III	Indirect Labor (\$) Col. IV	Overhead Col. V
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Total					

Total Assembled Cost/Unit = \$

Company Level Allocations/Unit = \$

THE ENVIRONMENTAL PROTECTION AGENCY

CAGI MEMBER FIRMS RESPONDING
TO KEARNEY'S COST INQUIRY

<u>Manufacturer</u>	<u>Plant Location</u>
Gardner-Denver*	Quincy, Illinois
Ingersoll-Rand*	Mocksville, North Carolina
Joy Manufacturing Co.	Michigan City, Indiana
	Clairmont, New Hampshire
Le Roi Division (Dresser Industries)	Sidney, Ohio
Quincy Compressor Division* (Colt Industries, Inc.)	Quincy, Illinois
Schramm, Inc.*	West Chester, Pennsylvania
Smith, Gordon & Co.*	Bowling Green, Kentucky

Note: *Follow-up visits were made to these plants.

Source: Kearney.

APPENDIX BBBN ENGINEERING COST ESTIMATES

BBN made a cost analysis based on engineered materials and labor cost estimates. This Appendix makes a comparison of increases in list prices associated with quieting based on BBN material and labor costs utilizing "margin" as assigned by BBN, and Kearney "full margin" and "incremental margin" as developed in Appendix A.

PORTABLE AIR COMPRESSORS
SELECTED FOR ANALYSIS

BBN selected three units for study. They were the Worthington 160 Monorotor (gasoline engine), the Atlas Copco VSS-170 Super Silenced (diesel engine), and the Worthington QTEX 750 "Blue Brute" (diesel engine). The table on the following page presents the noise emission levels of the three units selected for study and the corresponding sound level for standard units of the same air flow capacity and power source type produced by the manufacturer.

Table B-1Noise Emission Levels of
Units Selected for Study

<u>Unit and Manufacturer</u>	<u>Noise Emission Level⁽¹⁾</u>		<u>dBa Reduction</u>
	<u>Corresponding Standard Unit</u>	<u>Unit Selected for Study</u>	
160 Monorotor, Worthington	89 dBA	75 dBA	14 dBA
VSS-170 Super Silenced, Atlas Copco	82 dBA	70 dBA	12 dBA
QTEX-750 Blue Brute, Worthington	89 dBA	75 dBA	14 dBA

Note: (1) As measured under the ISO 2515 testing procedure.

Source: Bolt Beranek and Newman Inc.

From the table note that:

1. The Worthington 160 Monorotor meets the suggested Level One noise emission requirements. However, it must be quieted 1 dBA more to include the suggested 2 dBA tolerance.

2. The Atlas Copco VSS-170 Super Silenced meets the suggested Level One noise emission requirements including the suggested 2 dBA tolerance. It meets the suggested Level Two noise emission requirements. However, it must be quieted 2 dBA more to include the suggested Level Two 2 dBA tolerance.

3. The Worthington QTEX 750 Blue Brute meets the suggested Level One noise emission requirements including the suggested 2 dBA tolerance.

METHODOLOGY AND
COSTS OF QUIETING

BBN's calculation of quieting costs included the following factors:

1. Incremental direct material was determined.
2. An OEM markup of 1.5 was used. This markup was estimated based on concrete mixer truck experience.
3. Incremental direct labor was determined. A labor rate of \$5.00 per hour was used.
4. Burden was estimated at 1.4 times labor dollars.
5. A distributor markup of 1.23 was used.

On this basis, the following formula was used to determine quieted portable air compressor list prices. Note that M represents dollars of incremental material and L represents hours of incremental labor.

$$\text{Price} = 1.23 (1.5 \times M) + (5 \times L) + (1.4 \times 5 \times L)$$

or

$$\text{Price} = 1.23 (1.5 \times M) + (12 \times L)$$

Using the formula presented above, the list price increases resulting from noise abatement were developed as shown on the following page.

Table B-2BBN Estimates of Increases in
List Prices Due to Quieting

<u>Unit and Manufacturer</u>	<u>Total List Price Increase</u>	<u>List Price Increase per cfm per dBA</u>	<u>Net List Price Difference per cfm(1)</u>
160 Monorotor, Worthington	\$ 742	\$.33	\$4.64
VSS-170 Super Silenced, Atlas Copco	1,372	.67	8.08
QTEX-750 Blue Brute, Worthington	2,765	.28	3.69

Note: (1) The net price difference is based on the price difference per cfm between the projected price of the quieted unit and the price of a standard unit of the same air flow capacity and power source type.

Source: Bolt Beranek and Newman Inc.

BBN COST ESTIMATES
UTILIZING KEARNEY
MARGIN FACTORS

Margin determinants (the basis used to apportion overhead costs) often differ as a function of the specific expense to be allocated. To attain consistency in the comparison of increases in list prices associated with quieting, a calculation of increases in list prices based on BBN material and labor costs utilizing Kearney "full margin" and "incremental margin" as developed in Appendix A will be made.

(a) "Full Margin"

Using the Kearney "full margin" and the BBN material and

labor costs, list price increases resulting from noise abatement were developed.* These are shown in Table B-3 below.

Table B-3

Estimated List Price Increases Based
on BBN Material and Labor Costs and
Kearney "Full Margin"

<u>Unit and Manufacturer</u>	<u>Total List Price Increase</u>	<u>List Price Increase per cfm per dBA</u>	<u>Net List Price Difference per cfm(1)</u>
160 Monorotor, Worthington	\$ 597	\$.27	\$3.73
VSS-170 Super Silenced, Atlas Copco	1,058	.52	6.22
QTEX-750 Blue Brute, Worthington	2,235	.21	2.98

Note: (1) The net price difference is based on the price difference per cfm between the projected price of the quieted unit and the price of a standard unit of the same air flow capacity and power source type.

Sources: Bolt Beranek and Newman Inc.; and Kearney estimates.

* The list price increases based on Kearney "full margin" are derived using the following formula:

$$[\text{Direct Material}(1) + (\text{Direct Labor} \times \$5 \text{ per Hour})(2)] \div .7045 \\ (3) \times 1.333(4) = \text{Increase in List Price at Full Burden}$$

Notes: (1) Direct material estimates as made by BBN.

(2) Direct labor estimates as made by BBN x \$5 per hour.

(3) Estimate of the percentage of total manufacturing cost at full burden, represented by direct costs, i.e., direct material plus direct labor.

(4) 1.333 is the allowance for distributor discount which is estimated by Kearney as an average of 25% off list price.

(b) "Incremental
Margin"

Using the Kearney "incremental margin" and the BBN material and labor costs, the following list price increases resulting from noise abatement were developed.* These are shown in Table B-4 on the following page.

LIST PRICE
INCREASE COMPARISON

A comparison of the list price increases associated with BBN engineering cost estimates, BBN material and labor costs and Kearney "full margin," BBN material and labor costs and Kearney "incremental margin" and the BBN price analysis based on the marginal cost of quieting equaling average list price differences is presented in Table B-5.

* The list price increases based on Kearney "incremental margin" are derived using the following formula:

$$\left[\text{Direct Material}(1) + (\text{Direct Labor} \times \$5 \text{ per Hour})(2) + \text{Incremental Burden}(3) + \text{Profit}(4) \right] \times 1.333(5) = \text{Increase in List Price at Incremental Burden}$$

- Notes:
- (1) Direct material estimates as made by BBN.
 - (2) Direct labor estimates as made by BBN x \$5 per hour.
 - (3) An incremental 10% of the full burden dollars was allowed.
 - (4) A 10% after tax profit was allowed on the increased dollars tied up in inventory. These dollars reflect the total cost of direct material plus 25% of the incremental burden.
 - (5) 1.333 is the allowance for distributor discount which is estimated by Kearney as an average of 25% off list price.

Table B-4

Estimated List Price Increases Based on
BBN Material and Labor Costs and
Kearney "Incremental Margin"

<u>Unit and Manufacturer</u>	<u>Total List Price Increase</u>	<u>List Price Increase per cfm per dBA</u>	<u>Net List Price Difference per cfm(1)</u>
160 Monorotor, Worthington	\$ 453	\$.20	\$2.83
VSS-170 Super Silenced, Atlas Copco	798	.39	4.70
QTEX-750 Blue Brute, Worthington	1,698	.16	2.26

Note: (1) The net price difference is based on the price difference per cfm between the projected price of the quieted unit and the price of a standard unit of the same air flow capacity and power source type.

Sources: Bolt Beranek and Newman Inc.; and Kearney estimates.

Table B-5

Comparison of Quieting List Price Increases(1)

Table B-5 Comparison of Quieting List Price Increases(1)						
Noise Emission Level	Power Source Type and Air Flow Capacity	BBN Engineering Cost Estimates	BBN Material and Labor Costs and Kearney "Full Margin"	BBN Material and Labor Costs and Kearney "Incremental Margin"	BBN List Price Analysis w/o Tolerance(2) w/Tolerance(2)	Range of Difference(3)
Level One	Gasoline Engine, Below 251 cfm (All)	\$4.64	\$3.73	\$2.83	\$4.15	\$1.47-\$3.28 (w/tolerance)
	Diesel Engine, Below 301 cfm	8.08	6.22	4.70	6.23	.32- 3.70 (w/tolerance)
	Diesel Engine, Above 300 cfm	3.69	2.98	2.26	5.38	2.53- 3.96 (w/tolerance)
Level Two	Diesel Engine, Below 501 cfm	8.08	6.22	4.70	13.79	7.71-11.09 (w/o tolerance)

Notes: (1) This comparison is made on the basis of the net cost per cfm to bring the units BBN used for engineering cost estimates down to their present noise emission levels and the average net cost per cfm to bring all standard units down to the noise emission levels suggested for study.

(2) Tolerance is the 2 dBA tolerance between the level one average and the "not to exceed" sound levels.

(3) Range of difference is the range of difference between list price increases based on the BBN price analysis based on the marginal cost of quieting average list price differences and the three list price increases based on BBN engineering cost estimates.

Sources: Bolt Beranek and Newman Inc.; and Kearney estimates.

The table shows that:

1. List price increases associated with the BBN list price analysis with the 2 dBA tolerance are higher for each unit studied than those associated with the BBN engineering cost estimates, the BBN material and labor costs and Kearney "full margin" estimates, and the BBN material and labor costs and Kearney "incremental margin" estimates.

2. List price increases associated with the BBN engineering cost estimates are higher for each unit studied than those associated with the BBN material and labor costs and Kearney "full margin" and the BBN material and labor costs and Kearney "incremental margin."

3. List price increases associated with the BBN material and labor costs and Kearney "full margin" estimates are higher for each unit studied than those associated with the BBN material and labor costs and Kearney "incremental margin" estimates.

4. Significant differences in the amount of list price increase variation exist by method of calculation and power source type/air flow capacity category.

5. The list price increases in all cases imply that the costs to quiet small diesel units will be higher than the costs to quiet gasoline units of the same approximate air flow capacities.

APPENDIX C

COSTS OF ASSURING COMPLIANCE

At the request of the EPA, Kearney made an order-of-magnitude estimate of compliance testing costs based on the sound levels suggested for study. The compliance costs were estimated on a "not to exceed" basis. The EPA requested that the compliance scenario consider three different testing conditions reflecting different sampling requirements and levels allowing manufacturers to monitor themselves.

Each of the three conditions requires a validation procedure. Validation might require the submission of design information and require test results of the first completed production units. The test procedure to be used for validation is the procedure cited in "Measurement Methodology and Supporting Documentation for Portable Air Compressors, Second Draft Report", May, 1974, written by the Applied Acoustics Section, Mechanics Division, Institute for Basic Standards, National Bureau of Standards.

CONDITION ONE

Condition One entails Kamperman-type testing of 100% of the units produced with air flow capacities in excess of 500 cfm. For compressors with smaller air flow capacities, a 10% sample

of each production lot is used.* The statistical implication of the results of these tests would determine whether or not the entire production can be passed without further testing. Periodic reports of test results would be submitted to the EPA.

CONDITION TWO

Condition Two entails a 30% sampling rate of production lots for units with air flow ratings in excess of 500 cfm and a 3% sampling rate of production lots for units of less than 500 cfm. Acceptance determinations and report submission would be the same as for Condition One.

CONDITION THREE

Condition Three entails no report submission; however, it does require the manufacturer to be able to document that he has performed sufficient testing to assure that the units shipped comply with the proposed regulation.

COST CONSIDERATIONS

The three conditions and their related costs were discussed with the manufacturers visited (see Exhibit A-2). The manufacturers were asked to consider the costs shown on the following page.

* A production lot is defined as one or more units for which a common identification number is used by the accounting function. (Production lots are not equivalent to production batches--small numbers of units that may be final assembled at the same time in the same general shop area. A production lot is composed of one or more production batches.)

1. Capital Investment
 - (a) Land.
 - (b) Site preparation and construction.*
 - (c) Instrumentation.*
 - (d) Additionally required transportation equipment and storage capacity.
2. Annual Costs
 - (a) Debt service of capital expenditures.
 - (b) Depreciation or amortization.
 - (c) Taxes and insurance.
 - (d) Equipment maintenance and calibration.
 - (e) Labor.
 - (f) Fuel and power consumption.
3. Additional Costs
 - (a) Development cost associated with test procedures.
 - (b) Consulting services.

COST OF
COMPLIANCE

All of the firms contacted provided cost information for Conditions One and Two. Most manufacturers did not provide information for Condition Three because Condition Three is the most vague with respect to requirements and methodologies.

* The total capital cost of providing a fully equipped anechoic chamber is an alternative to (b) and (c).

Discussions with manufacturers and data analysis lead to the following conclusions:

1. Two test environments were considered for the purposes of responding to the compliance scenario. One conforms to the "test site" specifications found in the Kamperman proposal. The other test environment is provided through the use of an anechoic chamber.

2. Some manufacturers anticipate 100% sampling rates due to the number of units affected, the total labor required for this type of program, labor practices and the consequences of noncompliance. For these manufacturers, there is no distinction between Conditions One and Two.

Kearney's analysis resulted in an estimation of selected major cost items. These representative costs are presented in Table C-1 on the following page. Indicative values and ranges are presented because of the diverse methods used to prepare and present the requested information, the small number of firms responding, and the confidentiality of the information submitted.

Table C-1
Selected Representative Costs

<u>Capital Investments</u>	<u>Costs</u>
Land	\$ 20,000
Site Preparation and Construction(1)	5,000 - \$250,000
Instrumentation	12,500 -
Range (based on a Kamperman-type test site)	\$ <u>37,500 - \$250,000</u>
Anechoic Chamber	\$350,000
Composite Range	\$ 37,500 - \$350,000

Note: (1) The large cost range is due to location, terrain, and local construction costs.

Source: Kearney estimates based on information supplied by five manufacturers.

Costs per unit sold can be derived by prorating the total annual costs uniformly over the projected baseline forecast. On this basis, an order-of-magnitude estimate of cost per unit sold is:

1. Condition One - \$45.00-\$75.00.
2. Condition Two - \$40.00-\$60.00.

It is reasonable to expect that list prices will not be uniformly affected by a constant dollar amount irrespective of machine size. It is reasonable to assume that the absolute dollar list price increases attributable to the cost of assuring compliance will be related to the units list price.

APPENDIX DINDUSTRY COMMENTS AND VIEWS

BBN issued their preliminary draft report, "Portable Air Compressors: The Costs, Benefits, and Penalties of Reducing Their Noise" on September 14, 1973. A final draft of this report was issued on March 29, 1974. During the period between submission of the preliminary and final draft report, the following sequence of events occurred:

1. Noise Emission Levels Suggested for Study. The noise emission levels suggested for study in the preliminary draft report were suggested for study in the final draft report.
2. Technical Quieting Strategy. The preliminary report did not identify a characterization of on-the-shelf technology applicable to meeting each noise emission level suggested for study. During the course of Kearney field interviews conducted for the analysis of economic impact, portable air compressor manufacturers frequently requested information as to the nature of the technology required to achieve the levels of noise abatement selected for study. Therefore, BBN made some general characterizations based on selected quieted units currently on the market or prototypes, which appear in Exhibit D-1. BBN did not identify a characterization of on-the-shelf technology applicable to meeting each noise emission level suggested for study in their final draft report.

3. Costs of Quieting. The costs of quieting based on analysis of list price differentials using a sample of 194 units as cited in the preliminary draft report were changed in the final draft report due to a requirement to take into consideration a 2 dBA tolerance for a "not to exceed" standard.

It is not in the scope of Kearney's study to validate or adjust the technical and cost data provided by EPA through its contract with BBN as the basis for the assessment of economic impact. However, in the course of our study, manufacturers of portable air compressors provided information on their views of the data base being used for the study and on the developing noise regulation program. While not evaluating the validity of these views, Kearney believes that an understanding of industry viewpoints is essential background to its study. The following paragraphs provide a brief review of the major points made.

PROPOSED SOUND LEVEL LIMITS

The reaction of most manufacturers to the proposed sound level limits can be generalized as:

1. Level One and Level Two are technically possible.
2. The present state of sound suppression technology has not advanced to the point where they can make a judgment on whether or not Level Three is technically possible. Nearly all manufacturers stated that Level Three would be highly impractical. Major design modifications would be necessary.

In their judgment these modifications would most likely result in equipment efficiency reductions, maintenance cost increases, operating cost increases, and high overall costs to society.

TECHNICAL QUIETING STRATEGY

BNN did not identify a characterization of on-the-shelf technology applicable to meeting each noise emission level suggested for study in their final draft report, "Portable Air Compressors: The Costs, Benefits, and Penalties of Reducing Their Noise." However, they did make some general characterizations based on selected quieted units currently on the market or prototypes, which are:

1. Level One. Suggestions to attain Level One consisted of adding better mufflers, adequate enclosures and sound insulation to the compressor paneling.

2. Level Two. Suggestions to attain Level Two consisted of adding better mufflers, adequate enclosures, sound insulation to compressor paneling and vibration isolators.

3. Level Three. Suggestions to attain Level Three consisted of adding better mufflers, adequate enclosures, sound insulation to compressor paneling, vibration isolators, extensive enclosures with special insulation for cooling air ducts, and a more efficient fan.

Reaction to these suggestions was mixed as indicated on the following page.

1. Few manufacturers felt that Level One could be attained with the modifications suggested. Most manufacturers stated that vibration isolators are necessary to meet Level One.

2. Most manufacturers stated that Level Two cannot be attained by the recommended product modifications. These can be characterized as having one of two viewpoints:

- (a) More modifications will be necessary. Some manufacturers stated that to achieve Level Two extensive enclosures, sealing, cooling and air silencing ducts must be added. In addition, engine and engine cooling system modifications would probably be necessary.
- (b) Present noise reduction technology has not advanced to the point where accurate product modification/effect relationships can be predicted.

3. Nearly all manufacturers stated that Level Three cannot be attained by the recommended quieting strategy. Many further stated that the modifications necessary to attain Level Three would result in producing a product which would not be saleable on the market.

4. Manufacturers anticipate customer resistance. Customers are expected to balk at the expected price increases to pay for product modifications which yield no tangible economic benefits to them or which they do not believe yield significant benefits for the public. Few customers actually want noise emission suppression on portable air compressors.

COST
ESTIMATES

In accordance with the revised BBN study, industry reaction to the cost estimates to attain the proposed sound level limits was mixed, as indicated in the characterization below:

1. Level One. Manufacturers that presently have quieted units on the market generally agreed with the overall order of magnitude of the list price increases associated with the BBN list price analysis for the gasoline engine and diesel engine, below 501 cfm units. However, they stated that the costs to quiet diesel engine, above 500 cfm units would be approximately 50% higher.

2. Level Two. Few manufacturers had experience in the production of portable air compressors which would meet Level Two noise emission requirements.

3. Level Three. Manufacturers had no estimates of the costs necessary to achieve Level Three. They basically did not agree that this level was technically feasible with current technology and therefore had no framework on which to base cost estimates.

Other manufacturers strongly disagreed with the BBN cost estimates and stated that noise reduction experience to date indicates that cost estimates in advance of actual development work are of doubtful value and usually "miss the mark."

LEAD
TIMES

Industry reaction to the proposed lead times can be summarized as follows:

1. A lead time of six months for the modifications necessary to achieve Level One is not adequate. One to two years was generally considered adequate.
2. The lead time of 18 months for the modifications necessary to achieve Level Two on an orderly basis should be extended to three or four years.
3. The lead time for Level Three cannot be estimated until the characteristics of a feasible noise reduction technology have been demonstrated.

OTHER INDUSTRY
COMMENTS

The industry representatives expressed other points which are of interest:

1. Industry representatives agreed that whatever noise emission levels are set to minimize disruption and impact:
 - (a) Noise emission levels should be explicit and well-defined.
 - (b) Tolerance definitions and levels should be explicit.
 - (c) Lead times should be specific and well-defined. Vague statements on reopening or reevaluating the standards should be avoided.
2. A definite noise emission level(s) should be set. Some manufacturers would prefer the level selected to be the

ultimate level with adequate lead time and assurance that no lower level would be reconsidered and set in the future. Others would prefer a known "stairstep" set of levels extending at least over a full model life. This will enable manufacturers to work toward firm goals and avoid using valuable resources to achieve goals which might later be revised.

3. The enforcement and certification procedures should be specified in advance, and exactly what is required of the manufacturer stated, including:

- (a) Test to be used and test procedure requirements.
- (b) Manufacturer test site requirements (if any).
- (c) Manufacturer testing requirements (if any).
- (d) Manufacturer quality control requirements (if any).
- (e) The enforcement procedure the EPA will use to test equipment for noise emissions.

4. Industry representatives feel that it is extremely important that potential substitute products have similar if not identical noise emission standards imposed. The most important substitute products for portable air compressors are stationary and other compressors, hydraulic systems, high cycle electric systems and conventional electric systems.

5. Manufacturers pointed out that the engine is the major cause of noise. Portable air compressor manufacturers do not have the purchasing power to collectively force the engine

manufacturers to make noise suppression modifications. Therefore the feeling exists that engine manufacturers should also be regulated. Manufacturers believe this would be very helpful in solving the problems of industries which manufacture products that use an engine as the power source.

6. Many manufacturers took exception to the categories proposed by BBN as not breaking at present competitive breakpoints. The most frequently offered alternative was gasoline engine, 75-124 cfm and 125-250 cfm; and diesel engine, 75-124 cfm, 125-249 cfm, 250-599 cfm, 600-899 cfm and 900 cfm and over.

THE ENVIRONMENTAL PROTECTION AGENCY
NOISE EMISSION LEVELS SELECTED FOR STUDY,
TECHNICAL QUIETING STRATEGY AND INITIAL
EQUIPMENT COSTS

Noise Emission Level and Suggested Quieting Strategy(1)	Gasoline Engine Below 251 cfm (All)		Below 500 cfm		Below 501 cfm	
	Initial Equipment Cost(2)	Noise Emission Level Suggested for Study(3)	Initial Equipment Cost(2)	Noise Emission Level Suggested for Study(3)	Initial Equipment Cost(2)	Noise Emission Level Suggested for Study(3)
Level One: Better Mufflers Adequate Enclosures Addition of Sound Insulation to the Compressor Paneling	\$ 6.11	74 dBA	\$ 8.40	74 dBA	\$ 6.22	76 dBA
Level Two: Better Mufflers Adequate Enclosures Addition of Sound Insulation to the Compressor Paneling	6.43	71 dBA	13.19	68 dBA	2.68	71 dBA
Level Three: Better Mufflers Adequate Enclosures Addition of Sound Insulation to the Compressor Paneling Vibration Isolators Extensive Enclosures with Special Insulation for Cooling Air Ducts More Efficient Fans	25.56	63 dBA	23.60	63 dBA	5.28	63 dBA

- Notes: (1) Based on available "on-the-shelf" technology.
- (2) Cost increases are estimated in additional dollars per cfm at the manufacturer retail list price level. These cost estimates include the 2 dBA "not to exceed" tolerance.
- (3) The noise emission levels suggested for study include the 2 dBA "not to exceed" tolerance.

Source: Bolt Beranek and Newman Inc.

APPENDIX E
PRODUCT APPLICATIONS AND
COMPETITIVE SYSTEMS

PRODUCT
APPLICATIONS

Portable air compressors power pneumatic tools at a job site. The prime function of the equipment is based on the principle of the displacement of air to work on or move material. Primary applications include the generation of air power for a variety of hand tools, hammers, and certain atomizing and conveying equipment. Some idea of the many uses of air compressors can be gained from the listing below:

1. For operating hand tools to:
 - (a) Cut material with circular or chain saws.
 - (b) Bore holes in timber members.
 - (c) Drill holes in rock or other crushable material.
 - (d) Dig out sticky material, such as clay.
 - (e) Break out crushable material, such as asphalt or concrete.
 - (f) Vibrate poured concrete for denser final set.
 - (g) Chip rough edges off parts to finish poured and set material.
 - (h) Drive rivets into place.
 - (i) Tighten or loosen structural bolts.
 - (j) Tamp earthfill material for improved consolidation.

2. For many uses in tunneling, such as:
 - (a) Drilling holes to load for blasting or rock bolts.
 - (b) Blowing out rock cuttings from drilled holes.
 - (c) Aerodynamic power to move drifters and jack other equipment in the tunnel.
 - (d) Blowing out explosive, noxious fumes from the tunnel atmosphere.
3. For mixing and atomizing to shoot fine particle material, such as paint or cement gunnite.
4. As a means to carry through a pipe small particle materials, such as cement, fine dry sand or other mixing materials.
5. For an air-operated centrifugal pump.
6. For an air-powered hoist drum or brake.
7. For snow production.

Portable air compressors can be used to power a wide variety of equipment. However, 18 types of equipment account for in excess of 70% of portable air compressor unit usage. These are identified in the primary usage column in Table E-1, on the following page, which lists all important equipment powered by portable air compressors.

Table E-1Equipment Powered by
Portable Air Compressors

Estimated		
Percent Utilization of Total Air Flow Capacity Generated		
70%-80%	15%-30%	1%-5%
<u>Primary Usage</u>	<u>Secondary Usage</u>	<u>Minor Usage</u>
Backfill Tamper	Cable Cutter	Chain Saw
Brake	Clipping Hammer	Chain Saw
Centrifugal Pump	Drill	(Long Reach)
Clay Spade	Grinder	Circular Saw
Compactor	Hammer	Circular Saw
Concrete Vibrator	Nutrunner	(Long Reach)
Ground Rod Pusher	Polisher	Hedge Trimmer
and Puller	Pruner	Reciprocating Saw
Gunnite Applicator	Reamer	
Hoist Drum	Riveter	
Impact Wrench	Sander	
Paint Sprayer	Screwdriver	
Paving Breaker		
#60 Class		
Paving Breaker		
#80 Class		
Paving Breaker		
#500 Class		
Pile Driver		
Rock Drill		
Sand Blaster		
Snow Production		

Source: Industry interviews.

OTHER AIR SUPPLY
SOURCES

Other sources of air can be used to operate pneumatic tools. There are stationary, power take-off, self-propelled, and truck-mounted air compressors. These sources are potential substitutes for portable air compressors.

(a) Stationary Air
Compressors

Stationary air compressors are units designed to operate in one place. They are typically powered by electric motors with either air or water cooling. Stationary air compressors and portable air compressors are generally not directly competitive for most applications. Stationary air compressors dominate the mining and industrial markets. Portable air compressors are generally used only for auxiliary and mobile air requirements in these markets. In the construction and government markets competitiveness depends primarily on job location and situation. Portable air compressors have advantages on jobs which require the constant movement of equipment and where an electric power source is not readily available. Stationary air compressors have advantages on jobs where little movement of equipment is required and there is easy access to an electric power source. Generally the job site situation makes the decision of which type of compressor to purchase an easy one.

Prices of stationary air compressors are generally less than for comparable portable air compressors. Exhibit E-1 presents list price comparisons of portable and stationary air systems. Table E-2 summarizes the comparison for models on a price per cfm basis.

Table E-2

Comparison of Standard Portable
Air Compressor and Stationary
Air Compressor List Prices per cfm

<u>Air Flow Capacity Range (cfm)</u>	<u>Stationary Air Compressor List Price per cfm</u>	<u>Portable Air Compressor List Price per cfm</u>
120- 140	\$39.09	\$50.20
180- 200	29.57	39.27
230- 250	30.70	51.98
720- 760	21.86	42.44
900- 920	21.32	44.30
1,170-1,250	19.77	45.36
1,500-1,630	19.56	39.93
1,750-1,780	21.95	39.54

Source: Exhibit E-1.

From the table note that:

1. The prices of stationary units are significantly lower than portable units--over 20% lower in all cases.
2. As the air flow capacity increases, stationary air compressors tend to have a large price advantage over portable air compressors.

These prices apply when an electric power source of the correct voltage is available. However, if an electric power source is not available, a generator must be purchased to provide electric power. Table E-3 shows a comparison of portable air compressor and stationary air compressor/generator systems.

Table E-3

Comparison of Standard Portable Air Compressor
and Stationary Air Compressor/Generator
System List Price per cfm

Air Flow Capacity Range (cfm)	Stationary Air Compressor/ Generator System List Price per cfm	Portable Air Compressor List Price per cfm
120- 140	\$86.02	\$50.20
180- 200	63.78	39.27
230- 250	75.90	51.98
720- 760	52.26	42.44
900- 920	55.38	44.30
1,170-1,250	48.03	45.36
1,500-1,630	48.63	39.93
1,750-1,780	53.11	39.54

Source: Exhibit E-1.

From the table note that:

1. The prices of stationary air compressor/generator systems are greater than portable air compressor systems.
2. As the air flow capacity range increases, the price differential between the two systems narrows.

The total price per cfm shown for stationary air compressor/generator systems cannot be directly related to the figures cited for portable air compressors. The latter prices represent a complete system capable of providing service. The stationary air compressor/generator system prices include only the basic compressor, generator and respective housings. To provide service in the field these components must be coupled and properly mounted. They must also be transported to and from the job site. The smaller generators--those powering compressors rated under 500 cfm--can be carried on two-wheel towable trailers. The

larger units require a flat-bed trailer and therefore a tractor. In addition, the larger units require separate fuel storage systems and starting motors, the cost of which can be appreciable.

The operational costs of stationary air compressor/generator systems are more as energy must be converted twice instead of once. Maintenance costs are comparable.

(b) Power Take-Off
Air Compressors

Power take-off (PTO) air compressors are designed to be attached as an integral part accessory to a truck or construction equipment unit. PTO compressors are generally used only in the lower air flow capacity ranges. They can be substituted for portable air compressors in any application with air requirements up to 250 cfm.

Presently, PTO sales have been limited to applications such as utility company pole installation where the compressor must be frequently moved from place to place on the job site. This is due to high initial investment and operational and maintenance costs. Air compressor industry manufacturers estimate that the initial cost of a 125 cfm PTO air compressor, including the truck and installation, runs between \$8,000 and \$10,000 depending on the truck selected. This compares to an average list price of \$5,332 for a 125 cfm gasoline engine portable air compressor. Fuel consumption is generally higher for PTO air compressors. Constant PTO use causes excessive truck maintenance requirements.

(c) Self-Propelled
Air Compressors

Self-propelled air compressors are units that are an integral part of a tractor which is equipped with a loader, backhoe or drilling rig. The power source is designed with the engine and compressor cylinders incorporated in a single block. Schramm and Le Roi currently make self-propelled air compressors.

Presently, sales of self-propelled air compressors have been limited to applications such as track laying or pipe installation where it is advantageous to move the air source with earthmoving equipment. This is due to high initial investment and maintenance costs. The initial cost of a self-propelled air compressor mounted on the tractor frame (without earthmoving attachments) is approximately \$8,700. This compares to an average list price of \$6,201 for a 160 cfm gasoline engine portable air compressor. Fuel consumption cannot be directly compared. However, industry manufacturers stated that when all factors are accounted for, if the operational costs of the compressor only are considered, they are comparable. Maintenance costs are generally higher for self-propelled units due to compressor inaccessibility and dual use.

(d) Truck-Mounted
Air Compressors

Truck-mounted air compressors are portable air compressors, less running gear, mounted on a truck. Applications for truck-mounted air compressors are identical to those for portable

air compressors. Truck-mounted air compressors offer the advantage of ease of mobility. However, the load capacity of the truck is reduced and the truck is not available for other applications when the air compressor is in use. Air compressors less running gear generally cost 2% to 7% less than portable air compressors. Operational and maintenance costs are the same. Sales have been restricted due to the requirement of tying up the truck.

COMPETITIVE SYSTEMS

Two systems currently compete with pneumatic systems utilizing portable air compressors. These are hydraulic and electric systems. Substitutability depends on capability in specific applications and cost differentials. Generally, electric systems are competitive with pneumatic systems where there are low energy requirements. Applications are primarily in the industrial plant. Hydraulics are competitive in applications which require high energy output as is typical in the construction industry.

(a) Electric Systems

Electric systems provide the main competition for pneumatic systems in situations where small, light tools with low energy output are required. Generally the power is brought in from outside. If the power is generated in-plant, the source of the power is centrally located and is most often sound-isolated.

In both cases, power (electrical) outlets are near the site of the work to be performed and tools to be used.

There are two types of electric systems, high cycle and conventional. High cycle electric systems consist of a high cycle electric conversion unit and tools that run on 230 volt, 360-400 cycle current. Conventional electric systems are simply the standard 115 volt, 60 cycle electric systems most commonly in use in the United States. A high frequency system will require about the same amount of electrical energy as a conventional electric system. The cost of energy to run electric systems is approximately one-fifth of the energy cost for comparable pneumatic systems. High frequency tool prices are slightly higher than air tool prices for the same application. Conventional electric tool prices are generally one-third to one-half that of comparable air tools. Maintenance costs are higher for electric tools. Pneumatic tools last approximately twice as long as high cycle tools and four times as long as conventional electric tools.

Both high cycle and conventional electric power systems have no noise associated with the system itself other than generation, which is usually off-site. The only objectionable noise may come from the operation of the tools themselves (i.e., impact noise, whine, etc.). However, the noise level associated with the operation of electric tools is thought to be lower than that from pneumatic tools.

The major conventional electric industrial tool manufacturers are Black and Decker, Bosch, Milwaukee, Rockwell, Skil, Stanley and Thor. Bosch is currently the only major manufacturer of high cycle systems. However, the other major power tool manufacturers are continually reevaluating the possibility of entering the high cycle system market. They will do so if and when the cost advantages of high frequency systems are such that they can successfully compete against pneumatic systems.

(b) Hydraulic Systems

Hydraulic systems make use of a specially designed hydraulic pump as the power generator near the operator and hydraulic cylinders located at the strategic points (in the tools) for performing the work. The system operates by the pressure transmitted when a quantity of hot oil is forced through a hose line to the power tool. Hydraulic systems are superior in applications which require consistent holding power.

Hydraulic systems have been used in the construction industry in the past to power large tools mounted on construction equipment. Hydraulic systems for hand held tools are presently in the development stage. The introduction of a good hydraulic pavement breaker has opened the market for hydraulics in applications formerly dominated by pneumatics in the construction industry. Hydraulic systems will make further inroads as additional tools are developed. As the technology changes from a developing one to a mature one, more manufacturers will move into this market.

Hydraulic systems appear to have some advantages over pneumatic systems in specific applications which require variable loading, e.g., breakers and pile drivers. The advantages are quieter operation and a system requiring a smaller power source input to achieve the equivalent power output of a pneumatic tool. The estimates of the difference in power source input vary from 2:1 to 4:1. No detailed definitive comparisons have been made by the manufacturers or end users in the industry.

Another significant advantage appears to be one of cost. Although the capital cost of the individual hydraulic tools is usually greater, the total systems costs (tool and hydraulic compressor) are usually lower for comparable applications. This may vary from 5% to 75% depending on specific applications, number of tools required and system size. Industry respondents familiar with hydraulic systems indicate that 35% to 40% lower for comparable applications is a good average. Table E-4 shows a comparison of pneumatic and hydraulic average total systems costs for applications utilizing pavement breakers.

Table E-4

Comparison of Pneumatic and
Hydraulic Total Systems Costs⁽¹⁾

Number of Breakers	Pneumatic Power Source			Hydraulic Power Source			Percent of Pneumatic System Cost
	Breaker(2)	Portable Air Compressor	Total	Breaker(6)	Oil Presser	Total	
1	\$ 725	\$4,083 ⁽³⁾	\$4,808	\$1,070	\$ 925 ⁽⁷⁾	\$1,995	41.5%
2	1,450	5,599 ⁽⁴⁾	7,049	2,140	2,195 ⁽⁸⁾	4,335	61.5
3	2,175	6,201 ⁽⁵⁾	8,376	3,210	4,495 ⁽⁹⁾	7,705	92.0

- Notes:
- (1) Industry sources indicate that a 75 lb. hydraulic breaker and an 80-90 lb. pneumatic breaker do equivalent work.
 - (2) The price of a typical 80-90 lb. pneumatic breaker.
 - (3) A 100 cfm portable air compressor is required to run one 80-90 lb. breaker. The average list price of a 100 cfm gasoline unit is \$4,083.
 - (4) A 160 cfm portable air compressor is required to run two 80-90 lb. breakers. The average list price of a 160 cfm gasoline unit is \$5,599.
 - (5) A 185 cfm portable air compressor is required to run three 80-90 lb. breakers. The average list price of a 185 cfm gasoline unit is \$6,201.
 - (6) The price of a typical 75 lb. hydraulic breaker.
 - (7) The price of a typical hydraulic power source capable of running one 75 lb. breaker.
 - (8) The price of a typical hydraulic power source capable of running two 75 lb. breakers.
 - (9) The price of a typical hydraulic power source capable of running three 75 lb. breakers.

The table indicates that:

1. In all cases, hydraulic systems are less costly to purchase at the list price level.
2. As the number of breakers increases, prices become more competitive between the two systems.

In terms of maintenance and operational costs, both construction industry opponents and proponents of hydraulics indicate that there are little data to provide a valid comparison. Some say that because the hydraulic system utilizes oil as an operating medium, tool life is inherently longer. On the other hand, because the field of hydraulics is considered a developing technology, it is estimated by some industry sources that operational and maintenance costs will be higher until some degree of standardization is achieved between and among oil pressors and tools.

Hydraulic systems have some disadvantages, which are non-standardization of fittings and other system elements, bulkiness of the hydraulic lines and potential hot oil spills.

(c) Potential
Substitution

Potential substitution of hydraulic and electric systems for current portable air compressor applications depends upon the technical capability and cost differential between the systems. Based on current cost differentials, hydraulics are beginning to penetrate pneumatic applications. Furthermore, electric systems compete in applications where they are a feasible alternative. Table E-5, presents an assessment of the level of potential substitution based on technical capability and current pricing relationships.

High substitution indicates some current substitution with greater penetration into pneumatic applications expected at present price differentials. Medium substitution indicates some technical capability but greater price differentials required to get significant substitution. Low substitution reflects very marginal technical capability with little penetration from greater price differentials between systems.

Table E-5

Assessment of the Potential for Substitution of
Competitive Systems for Pneumatic Tools

<u>Pneumatic Tools</u> <u>Primary Usage</u>	<u>Competitive Systems</u>	
	<u>Hydraulic</u>	<u>Electric</u>
Backfill Tamper	H	M
Brake	M	L
Centrifugal Pump	H	M
Clay Spade	H	M
Compactor	H	M
Concrete Vibrator	M	H
Ground Rod Pusher and Puller	H	L
Gunnite Applicator	L	L
Hoist Drum	H	L
Impact Wrench	H	M
Paint Sprayer	L	L
Paving Breaker #60 Class	H	M
Paving Breaker #80 Class	H	M
Paving Breaker #500 Class	H	M
Pile Driver	H	M
Rock Drill	H	L
Sand Blaster	L	L
Snow Production	L	L
 <u>Secondary Usage</u>		
Cable Cutter	H	L
Clipping Hammer	H	M
Drill	H	H
Grinder	L	H
Hammer	M	H
Nutrunner	M	H
Polisher	L	H
Pruner	M	H
Reamer	H	H
Riveter	M	H
Sander	L	H
Screwdriver	M	H
 <u>Minor Usage</u>		
Chain Saw	L	H
Chain Saw (Long Reach)	L	H
Circular Saw	L	H
Circular Saw (Long Reach)	L	H
Hedge Trimmer	L	H
Reciprocating Saw	L	H

Key: H - High Substitution; M - Medium Substitution;
L - Low Substitution.

Source: Industry interviews.

Note that a high percentage of the primary applications for pneumatic tools have a high potential of substitution of hydraulic systems. Electric systems have a high potential primarily in secondary and minor applications of pneumatic tools.

INTEGRAL PNEUMATIC AND HYDRAULIC TOOLS

There are currently a number of pneumatic and hydraulic systems where tools are mounted on construction equipment units or special mobile tool carriers. The pneumatic tools generally receive air from supply lines run to the tool from portable air compressors. The hydraulic tools generally receive hydraulic oil from the equipment hydraulic system. Some typical applications are crawler-mounted drills, backhoe-mounted breakers, backhoe-mounted tampers, and pile drivers.

As the price of separate tools and power sources rises (due to quieting costs and possible lower standards for noise applied to stationary power sources), the potential for integrating tools and power source more economically will increase. Equipment pneumatically driven (similar to a track drill) with an integral air compressor and breaker(s) may be economically feasible. Such substitution can occur for integrated pneumatic or hydraulic power source/tools.

Substitution of integrated tools can occur in both pneumatic and hydraulic power source/tools. If costs are favorable for

the integrated power source/tools, hand held tools could also be operated on a PTO basis. It should be noted that in the construction industry there has been a general trend toward use of more equipment controlled tools and more specialized tool equipment.

SUMMARY

The potential of substitution of other air sources, hydraulic systems or electric systems for applications of current portable air compressors will depend on:

1. The extent of price increases caused by the application of quieting technology to portable air compressors.
2. The technical feasibility of producing the required air supply under the specific working conditions of the portable air compressor applications.
3. The timing extent and costs of noise regulations on competitive power systems, all types of available tools, and construction equipment which may be developed for integrating tools or used for PTO. These regulations will impact on cost differentials in each application.

THE ENVIRONMENTAL PROTECTION AGENCY

AVERAGE CURRENT LIST PRICES FOR STATIONARY
AIR COMPRESSORS AND TYPICAL GENERATOR PRICES

Air Flow Capacity Range (cfm)	Stationary Air Compressor List Price (1)	Price /cfm (2)	Typical Generator List Price (3)	Total Price (4)	Total Price /cfm (5)	Comparable Standard Portable Air Compressor Price/cfm (6)
120-140	\$ 5,082	\$39.09	\$ 6,100	\$11,182	\$86.02	\$50.20
180-200	5,618	29.57	6,500	12,118	63.78	39.27
230-250	7,367	30.70	10,850	18,217	75.90	51.98
270-290	7,412	26.47	10,850	18,262	65.22	-
340-360	9,822	28.06	16,000	25,822	73.78	-
460-490	12,788	26.92	16,000	28,788	60.61	-
610-630	14,856	23.96	20,000	34,856	56.22	-
720-760	16,176	21.86	22,500	38,676	52.26	42.44
900-920	19,400	21.32	31,000	50,400	55.38	44.30
970-1,000	20,756	21.07	31,000	51,756	52.54	-
1,170-1,250	23,922	19.77	34,200	58,122	48.03	45.36
1,500-1,630	30,604	19.56	45,400	76,104	48.63	39.93
1,750-1,780	38,745	21.95	55,000	93,745	53.11	39.54

Notes: (1) Average stationary air compressor list price is based on stationary air compressor list prices obtained from five manufacturers.

(2) Price per cfm is the result of dividing the list price by the median capacity within each capacity range.

(3) Generator prices include only basic unit and housing; transportation, separate fuel system, couplings, etc. are not included.

(4) Total price is the sum of the average stationary air compressor list price and typical generator list price.

(5) Total price per cfm is the result of dividing the total price by the median capacity within each capacity range.

(6) See Exhibit V-5.

Sources: Exhibit E-2; and stationary air compressor and generator manufacturers.

EXHIBIT E-1

THE ENVIRONMENTAL PROTECTION AGENCY
ESTIMATED PRICE INCREASE BY
AIR FLOW CAPACITY AND NOISE LEVEL

Power Source Type	Air Flow Capacity (cfm)	Average List Price (1)	Cost / cfm (2)	Level One (4)		Average Price Increase (5)	Adjusted Price / cfm (7)	Average Price Increase (8)	List Price (9)	Adjusted Price / cfm (10)	Level Three		Average Price Increase (11)	Adjusted Price / cfm (12)	Rental Price / cfm (14)
				Adjusted List Price (6)	Adjusted Price / cfm (4)						Adjusted List Price (13)	Adjusted Price / cfm (11)			
Gasoline	85	\$ 3,835	\$45.11			\$ 519	\$51.32	\$ 1,066	\$ 4,901	\$57.66			\$ 3,238	\$83.31	\$2.05
	100	\$ 4,093	\$40.83	\$ 4,354	\$43.54	611	46.84	1,174	5,517	53.37	\$ 7,073	70.73	3,810	78.53	1.94
	125	\$ 5,332	\$42.66			764	48.77	1,568	6,900	55.20			4,763	80.76	1.79
	150	\$ 5,599	\$36.99	\$ 6,577	\$65.77	976	41.11	2,006	7,603	47.33	10,095	10.095	6,096	73.09	1.57
Diesel	185	\$ 6,201	\$33.52	7,325	\$73.25	1,130	39.59	2,320	8,521	46.06	11,695	11.695	7,049	71.62	1.64
	175	\$ 6,275	\$50.20			1,050	28.60	2,699	8,974	71.79			5,649	95.39	2.15
	180	\$ 6,577	\$40.80	7,821	\$78.21	1,344	47.19	3,454	9,981	62.38	11,924	11.924	7,230	85.98	1.71
	185	\$ 7,266	\$39.27	8,820	\$88.20	1,554	47.68	3,994	11,260	60.87	15,626	15.626	8,360	84.46	1.89
	250	\$ 12,984	\$31.98			2,100	60.37	5,398	18,382	73.57			11,298	97.17	1.84
	365	\$ 18,673	\$31.16	21,739	\$21.739	3,066	59.56	7,880	28,553	72.74	24,292	24.292	16,594	96.34	1.85
	600	\$ 26,185	\$43.64			3,722	49.86	5,340	31,525	52.54			8,508	57.82	1.65
	750	\$ 31,829	\$42.44	29,917	\$29.917	4,665	48.66	6,675	38,504	51.34	34,693	34.693	10,635	56.61	1.32
	900	\$ 38,667	\$44.30			5,598	45.465	8,010	47,877	53.20			12,762	58.47	1.58
	1,050	\$ 43,942	\$43.75	52,673	\$52.673	6,531	49.42	10,365	55,287	52.65	52,651	52.651	16,589	59.53	1.38
	1,200	\$ 45,26	\$42.36	61,892	\$61.892	7,464	51.58	10,800	65,108	54.26			17,016	60.81	1.30
	1,600	\$ 57,800	\$35.50	73,852	\$73.852	9,952	66.16	14,260	86,170	48.94			22,880	54.11	1.30
	1,750	\$ 65,200	\$39.54	80,085	\$80.085	10,685	65.76	15,575	88,775	48.44			24,815	53.72	1.31

Notes: (1) The air flow capacity categories in this column represent the capacity of the most popular units.

(2) Average list price is the average list price for standard units as derived in Exhibit III-7.

(3) The cost per cfm is calculated by dividing the average list price by the capacity.

(4) Only standard units are considered in the Level One estimates.

(5) The average price increase is the average increase in list price resulting from making the adjustments necessary to bring a standard unit up to Level One noise emission requirements according to the BBN data as shown in Table II-3.

(6) The adjusted list price is the new list price for units meeting the Level One noise emission requirements. This is calculated by adding the average price increase to the list price.

(7) The adjusted price per cfm is the new compressor price per cfm resulting from meeting Level One noise emission requirements.

(8) The average price increase is the average increase in list price resulting from making the adjustments necessary to bring a standard unit up to Level Two noise emission requirements according to the BBN data as shown in Table II-3.

(9) The adjusted list price is the new list price for units meeting the Level Two noise emission requirements. This is calculated by adding the average price increase to the list price.

(10) The adjusted price per cfm is the new compressor price per cfm resulting from meeting the Level Two noise emission requirements.

(11) The average price increase is the average increase in list price resulting from making the adjustments necessary to bring a standard unit up to Level Three noise emission requirements according to the BBN data as shown in Table II-3.

(12) The adjusted list price is the new list price for units meeting the Level Three noise emission requirements. This is calculated by adding the average price increase to the list price.

(13) The adjusted price per cfm is the new compressor price per cfm resulting from meeting the Level Three noise emission requirements.

(14) The rental price per cfm is the rental rate per cfm according to Associated Equipment Distributors, 1972 Rental Compilation.

APPENDIX F
PRINCIPAL END USE MARKETS

The principal end use markets for portable air compressors are:

1. Construction. The construction industry is the largest end use market for portable air compressors. Approximately two-thirds of total sales and rentals are to this industry. In 1973, new construction put in place was approximately \$136 billion or about 11% of the Gross National Product.

The primary classifications of construction are building, public works and other non-building construction. Building construction includes:

- (a) Residential - single-and multi-family units.
- (b) Commercial and institutional - offices, hospitals, schools, public buildings, etc.
- (c) Industrial - industrial, service, repair, and other miscellaneous buildings.

Public works and other non-building construction includes:

- (a) Utilities - telephone, electricity, gas, railroad and pipelines.
- (b) Highways and streets.
- (c) Water use and control - Water supply facilities, sewer systems, and conservation and development projects.
- (d) Other - farm construction, military facilities and other miscellaneous public and private construction.

The estimated level of activity by type of construction in 1973 is shown in Table F-1 below:

Table F-1

Estimated New construction Put in Place
by Type of Construction, 1973

<u>Type of Construction</u>	<u>New Construction (\$Billions)</u>	<u>Percent of Total</u>
Building		
Residential	\$ 58.0	42.5%
Commercial and Institutional	33.0	24.2
Industrial	<u>7.3</u>	<u>5.4</u>
Subtotal	\$ <u>98.3</u>	<u>72.1%</u>
Public Works and Other Non-Building		
Utilities	15.8	11.6%
Highways and Streets	11.0	8.1
Water Use and Control	5.5	4.0
Other	<u>5.8</u>	<u>4.2</u>
Subtotal	\$ <u>38.1</u>	<u>27.9%</u>
Total - All Construction	<u>\$136.4</u>	<u>100.0%</u>

Source: U.S. Department of Commerce,
U.S. Industrial Outlook, 1974.

Product shipments by all producers of construction machinery and equipment were \$5,295 million in 1972 and \$5,770 million in 1973. Portable air compressor sales represent approximately 1% to 2% of the dollars spent each year for construction equipment.

The principal portable air compressor applications in the construction industry are in commercial, institutional and industrial building construction and in public works and other non-building construction. It can be seen from the preceding

table that these types of construction represent 57.5% of total construction activity. The principal portable air compressor applications include production of compressed air to run paving breakers, backfill tamps, clay spades, paint spray guns, sand-blasters, pile drivers, rock drills and fastening tools. These applications are typically a more significant cost element in non-building construction than in building construction.

2. Industrial. The principal industrial portable air compressor users are chemical plants, petroleum and gas companies, and the maritime industry. These industries generally use stationary air compressors as their primary air source. However, portable air compressors are used where portability and mobility are essential and to fulfill peak requirements. Principal applications include:

- (a) Production of compressed air to run minor construction and maintenance equipment such as paving breakers, backfill tamps, clay spades, paint spray guns, fastening tools, pneumatic conveyors, air-operated centrifugal pumps, and air-powered hoist or brakes.
- (b) As a power source to operate industrial air tools.

Typically, portable air compressor costs are an insignificant portion of total operational costs.

3. Mining. Mining companies generally use stationary air compressors as their primary air source. Portable air compressors are used where portability and mobility are essential and to fulfill peak requirements. The principal portable air compressor

applications in the mining industry are:

- (a) The production of compressed air to run large rock drills, including rotary and air track drills.
- (b) Blowing out rock cuttings from drilled holes.
- (c) Providing aerodynamic power to move equipment.
- (d) Blowing out explosive, noxious fumes from the mine atmosphere.

Secondary uses include production of air to power pile drivers, breakers, backfill tamps and clay spades. Portable air compressor applications include both underground ore extraction and surface mine operations. In most operations, annual costs for portable air compressors are a very small percentage of total costs.

4. Government and Other. Government includes all federal, state and local agencies. Applications include all those cited in Section III. The other category includes the remaining miscellaneous user categories such as forestry, winter sports, and farms.

Table F-2, on the following page, indicates the estimated distribution of unit shipments by end use market during the years 1967-1972.

Table F-2

Estimated Percentage of
Total Portable Air Compressor Unit
Shipments by End Use Market, 1967-1972

<u>End Use Market</u>	<u>Percent of Units Shipped</u>
Construction Industry	
Public Works and Other Non-Building Construction	50%
Commercial, Institutional, and Industrial Building Construction	20
Mining Industry	8
Industrial Users	7
Government Agencies	12
Other Users	<u>3</u>
Total	<u>100%</u>

Sources: Based on manufacturer product shipments, 1967-1974
and Kearney estimates.

The estimates in the above table indicate that:

1. The construction industry is the principal user of portable air compressors. This end use market represents 70% of total shipments. In this industry, public works and other non-building construction represents approximately 20%.
2. Government is the second largest end use market with approximately 12% of total shipments.
3. Mining and industrial users account for 8% and 7% of the total shipments, respectively.

APPENDIX G
CHANNELS OF DISTRIBUTION

This Appendix briefly describes the key economic characteristics of the distribution channels for portable air compressors and reviews customer purchasing considerations and ownership patterns.

PREDOMINANT DISTRIBUTION
METHODS

Portable air compressor channels of distribution are well-defined. The several types of distribution methods include:

1. Factory Branches and Factory-Owned Dealers. These include distribution outlets partially or wholly owned by equipment manufacturers. Factory branches are outlets owned entirely by the primary equipment manufacturer. They often perform a parts distribution role for dealerships.
2. Independent Authorized Distributors (Dealers). These include privately owned dealerships that sell, rent and service portable equipment distributors with a major equipment franchise. Air compressors are generally a secondary product line. The ownership of a dealership might be held by one man or several individuals who have formed a partnership or a corporation. In most cases, the owners actively participate in managing the business.
3. Direct Sales. Direct sales occur when the manufacturer sells equipment directly to the end user. Direct sales are often handled through a factory-owned branch or dealership.

Table G-1 indicates the predominance of each type of distribution method.

Table G-1

Estimated Percent of Portable Air
Compressor Unit Sales Derived
from Each Distribution Method

<u>Distribution Method</u>	<u>Percent of Unit Sales</u>
Factory branches and factory-owned dealers	25%
Independent authorized distributors (dealers)	70
Direct to end user	<u>5</u>
Total	<u>100%</u>

Source: Based on manufacturer responses and Kearney estimates.

CHARACTERIZATION OF
PORTABLE AIR COMPRESSOR
DISTRIBUTORS

As indicated in Table G-1, portable air compressors are most commonly sold to the end user by independent construction equipment distributors.

Construction equipment distributors can be categorized according to the major product lines in which they specialize. These are heavy equipment, general line construction equipment, and light industrial equipment. Portable air compressors are distributed by each of the three types. Construction equipment distributors sell new and used equipment, have short- and long-term lease operations, and sell parts and service. It is estimated that there are about 800 to 1,000 air compressor distributors in the country.

The three major types of construction equipment distributor operations are briefly described below:

1. Heavy Equipment. Heavy equipment distributors specialize in tractor and earthmoving equipment, including crawler and wheel tractors, loaders, motor scrapers, etc. They typically carry portable air compressors only as a supplement to their main product line. A small heavy equipment distributor's annual sales would typically be \$2 million and those of a large distributor \$14 million. Employment ranges from about 20 to over 200 for the largest distributors. Sales of equipment generally represent about 60% of sales. Gross profit (net sales minus cost of sales) for all operations is generally in the range of 20% to 25% of sales with a net profit after taxes of 1.5% to 3.0% of sales. The ratio of sales to net worth ranges from 7.4 to 1.0 for small firms to 5.6 to 1.0 for the larger firms.

2. General Line Construction Equipment. General construction equipment distributors usually handle a general line of construction equipment other than tractor and earthmoving equipment. They typically do a significant business in portable air compressors, although compressors are not generally the most important product lines. Employment of general line distributors ranges from 15 for smaller firms to over 50 for the larger firms. General construction equipment distributors typically have sales in the range of \$1 to \$6 million with gross profits of 20% to 27%. Net profit runs 1% to 3% of sales. The ratio of sales to net worth ranges from 7.8 to 1.0 for small firms to 5.0 to 1.0 for the larger firms.

3. Light Construction and Industrial Equipment. Light equipment distributors typically handle scaffolding, compactors, air compressors, vibrators, electrical tools, industrial tractors and related product lines. They do a significant business in portable air compressors, which are one of the primary product lines in their business. Often rental equipment represents in excess of 60% of sales. Employment ranges from 10 for smaller firms to over 25 for larger firms. Light construction equipment distributors characteristically have sales of \$0.7 to \$1.5 million and gross profit margins of about 30%, with net profits of 2% to 3% of sales.

The number of salesmen in a factory branch, factory-owned dealership and independent authorized dealership varies in relationship to the total volume. The largest single group of employees in most distributor operations is usually in the service and parts departments. It is usually about 50% of total employment.

Table G-2, below, presents a typical construction equipment distributor income statement.

Table G-2

Structure of a Typical Construction
Equipment Distributor Income Statement

	<u>Income and Expense Category</u>	<u>Percent</u>
	Net Sales	100.0%
Less	Cost of Sales	<u>77.0</u>
	Gross Profit	23.0
Less	Operating Expenses	<u>19.7</u>
	Operating Profit	3.3
Less	Other Income & Expense Net	<u>(.2)</u>
	Net Profit before Taxes	3.1
Less	Provision for Taxes	<u>1.2</u>
	Net Profit After Taxes	<u><u>1.9</u></u>
	Ratio of Net Sales to Net Worth	5.85 to 1
	Percent Return on Invested Capital	11.1%

Source: Associated Equipment Distributors.

STRENGTH OF DISTRIBUTOR
ORGANIZATION

Ingersoll-Rand and Gardner-Denver have a good system of factory branch outlets. In addition, a few manufacturers have a strong, independent authorized distributor system with good national coverage. The strength of distributor organizations varies by region and by product lines carried. Many distributors have not been able to develop strong financial capabilities.

However, the past few years of high demand for construction equipment have strengthened the financial position of many distributors.

DISTRIBUTOR/END USER
TRANSACTION METHODS

Customers may obtain ownership or use of portable air compressors from construction equipment distributors or factory branches in several ways. The most prevalent methods include:

1. Outright Purchase. Outright purchase consists of machinery purchases made without some form of direct equipment financing.
2. Financing. Financing consists of obtaining funds through national lending institutions (national banks, insurance companies, etc.), local banks, equipment dealers, manufacturers' credit organizations or finance companies. Loan periods vary and downpayments range from 10% to 50% of the purchase price.
3. Straight Lease. Leasing involves a rental agreement with no option to purchase. Normally, straight leasing is used where equipment is needed for only a short period, specialized equipment is required, or climatic conditions allow only partial utilization of equipment during the year. Rental rates are established based upon local supply and demand conditions and generally average 2%-4% of the machine value per month.
4. Lease-Purchase Agreements. Lease-purchase agreements may be written as (a) rental purchases (the lease may be converted to a purchase based upon previously agreed-upon terms) or (b) financial leases (although no conversion option is in the lease,

the equipment can be purchased for a nominal payment after the full purchase price has been paid in rentals). In addition to the same reasons used for straight leasing, lease-purchase arrangements are used to reduce capital expenditures, to develop sufficient equity in the machine to satisfy downpayment requirements, to try out a machine prior to purchasing it, and to maintain predictable machinery costs. Lease arrangements are often preferred to purchase and financing of equipment because of their more favorable impact on the company's financial statements with respect to meeting requirements for increased bonding.

Rental equipment is an extremely important factor in the portable air compressor market. In excess of 50% of portable air compressor manufacturer shipments of new equipment reach the end user via rental or rental-purchase agreements. The primary reason for such a high portion of portable air compressor rentals is that requirements generally arise on an intermittent basis. A typical end user might have some applications that necessitate the use of more than one compressor and at other times be in a stage where no applications are required. Presently, a strong trend is evident toward increased rental of portable air compressors.

Used equipment plays an important role in the portable air compressor market. Used equipment may be purchased either from end user owners or from trade-ins or rental equipment inventories of distributors. Many end user owners have a program of discarding equipment after a specified period. Rental agencies usually have a predetermined schedule of equipment life and trade time.

Most new equipment sales involve a trade-in of some kind.

Whether a potential customer is in the market for new or used equipment is generally dependent on the application for which the equipment will be used, the nature of the operation, the volume and expected backlog of work, the financial position of the customer and available financing. Such customer considerations generally provide the basis for determining whether new or used equipment is more economical for the purchaser.

Portable air compressors with air flow capacities of 75 cfm-249 cfm generally have an expected life of 8 to 10 years. Larger air flow capacity compressors generally have an expected life of 10 to 15 years. Beyond these typical periods, maintenance expense and downtime may become prohibitive at which point it is usually economical to replace the equipment.

Portable air compressors typically go through an ownership cycle which is characterized as follows.

1. First Owner. The first owner is typically a large contractor, industrial or mining company, or public body which has a constant portable air compressor requirement, or a rental agency (including compressor manufacturers and dealers that rent portable air compressors and equipment rental firms). Most first owners purchase new equipment to gain a cost and/or competitive advantage.

2. Second Owner. Second owners are typically smaller contractors, industrial or mining companies, or public bodies which have a more intermittent portable air compressor use

requirement, or rental users who purchase the compressor from the manufacturer or dealer on rental users who purchase the compressor from the manufacturer or dealer on a rental-purchase agreement.

3. Third Owner. The third owner is typically a concern which desires the compressor for only occasional use.

At each change of ownership, the transaction is usually handled through a construction equipment distributor who facilitates the process of moving used equipment through its ownership pattern in order to support the new equipment market.

PURCHASING CONSIDERATIONS

The selection of particular portable air compressors for specific jobs is a complex procedure. Several variables determine which brand and construction equipment distributor the customer chooses.

1. Past experience allows customers to make an accurate assessment of machine quality in terms of productivity and reliability.
2. Parts and service capabilities of local distributors and manufacturer support which permits the operator to minimize machine downtime.
3. Delivery within a relatively short period is often critical in selling customers who often do not place an order prior to obtaining a contract award.
4. The existing inventory of a customer's equipment

may affect his selection of specific brands. Standardization to reduce maintenance costs and increase operator productivity can be desirable.

5. Total ownership and operating cost comparisons will be made between competitive brands, including analyses of delivered cost, depreciable life, direct and indirect operating costs, and salvage value in terms of resale or trade-in. These comparisons will vary with the quality of support provided by the construction equipment distributor and manufacturer as well as the inherent quality of the unit with respect to the applications for which it will be used.

6. Consideration is given to list prices, discount structures, finance terms and trade-in allowances. Only machines in a competitive range will be given serious consideration.

7. Ease of maintenance and repair will influence customers who prefer those manufacturers who have simplified the design and assembly of their machinery to allow easier access to working parts and quicker repair.

APPENDIX HPORTABLE AIR COMPRESSOR
ASSEMBLY PROCESS AND
COMPONENT SUPPLY PATTERNS

Portable air compressor level of production sophistication varies by manufacturer. Plants vary significantly in size, efficiency, technology and employment. While some firms have efficient plants utilizing the most up-to-date technology and production methods, others have old, inefficient plants utilizing technology and production methods that are obsolete.

ASSEMBLY
PROCESS

Although each firm manufacturing portable air compressors employs certain processes which are unique or proprietary, the production process typically utilizes the production steps illustrated in Figure H-1. The finished product is usually assembled in stages. A detailed description of the production stages follows:

1. The engine is obtained.
2. The wiring harness, fan and alternator are installed on the engine (dress up engine).
3. The main structural members of the frame are assembled and welded to specification.
4. The axles are attached to the frame.
5. The wheels and tires are attached to the axles.
6. The engine is mounted on the frame.

7. The radiator and oil cooler are attached.
8. The air end is bolted to the flywheel housing.
9. The oil sump, oil receiver combination, piping and tubing are installed.
10. The inlet control valve and fuel tank are attached.
11. All inaccessible body section parts and panels are installed.
12. The wiring harness and operator control panel are installed and connected.
13. The unit is operationally tested and gauges calibrated.
14. Fenders, panels, front and rear end shells, grill work, guards, mufflers and the mounting structure are attached to the compressor body.
15. The compressor is sanded and painted.
16. Final processing, consisting of installation of the battery, name plates, reflectors, decals, etc. is accomplished.

This ends the production process and the portable air compressor is ready for a final quality control check before delivery to the dealer.

SUPPLY
PATTERNS

Corporations which manufacture portable air compressors generally manufacture certain components and purchase others.

Table H-1 cites responses from portable air compressor manufacturers that outline which components are manufactured and which are purchased.

Table H-1
Principal Component Source(1)

<u>Component Description</u>	<u>Number of Corporations Which Manufacture</u>	<u>Number of Corporations Which Purchase</u>	<u>Number of Corporations Which Manufacture and Purchase</u>
Frame	12	0	0
Engine	0	11	1
Compressor (air end)	12	0	0
Air Receiver	4	6	2
Hood	4	6	2
Running Gear	0	8	4
Radiator	0	12	0
Mufflers	0	12	0
Fan	0	12	0
Air Cleaners	0	12	0
Isolators	0	12	0
Other	0	4	8

Note: (1) Only 12 portable air compressor manufacturers responded to the principal component source discussion.

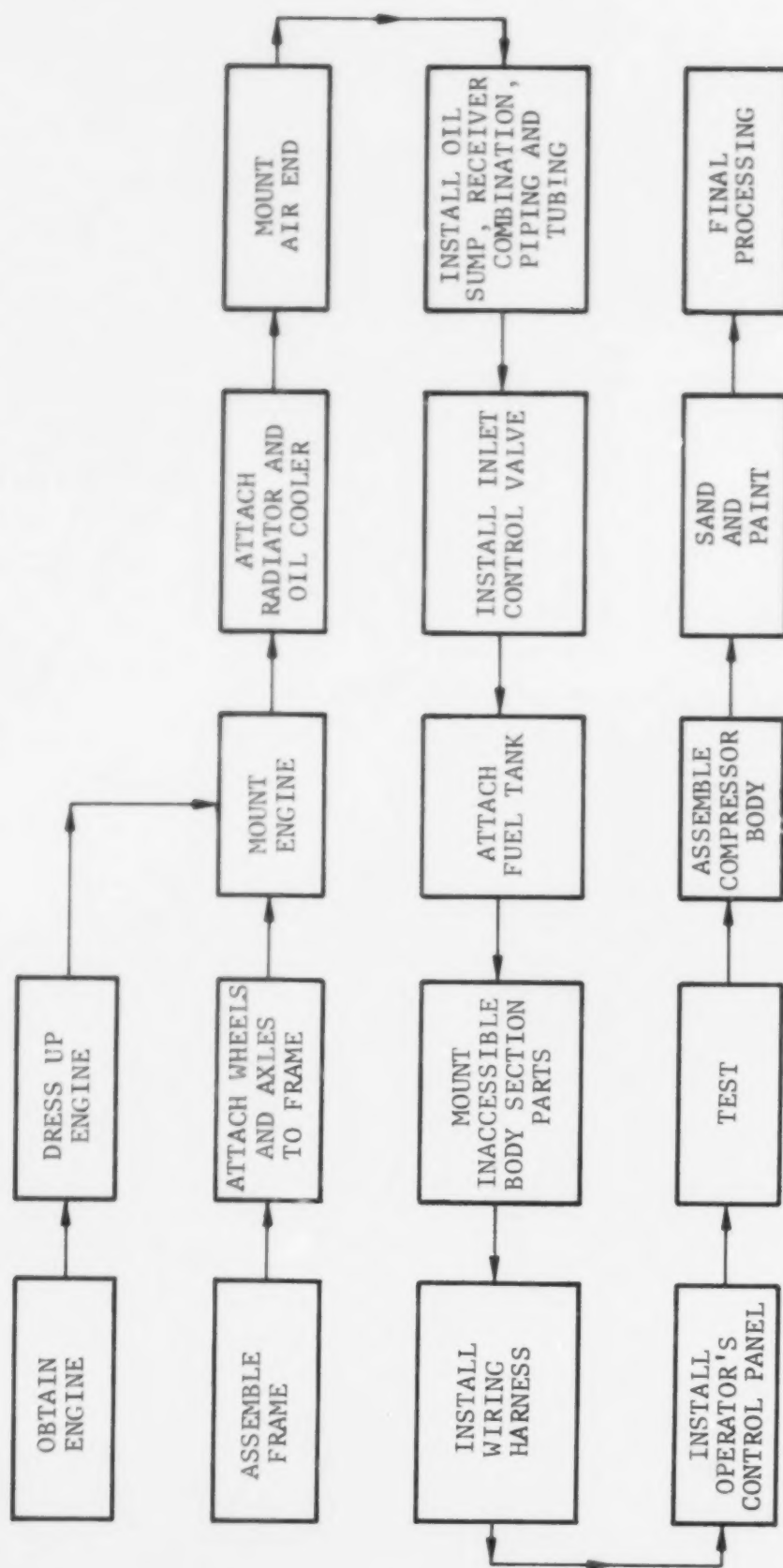
Source: Kearney interviews.

The table indicates that of the manufacturers who responded:

1. Most make their own air end and frame.
2. Air receivers and hoods are manufactured by some firms and purchased by others.
3. Running gear, radiators, mufflers, fans, air cleaners and isolators are purchased from outside sources.

Major raw material suppliers to the portable air compressor industry include iron and steel mills, foundries, forge shops, aluminum mills and copper producers.

Figure H-1
Portable Air Compressor Production Flow Diagram



APPENDIX ICALCULATION OF UNIT AND DOLLAR SHIPMENTS
OF PORTABLE AIR COMPRESSORS

The two primary sources of data for shipments of portable air compressors are the United States Department of Commerce and the Compressed Air and Gas Institute. However, certain differences exist between the data reported by the two sources. It is the purpose of this Appendix to examine the data reported by these sources, discuss the differences and arrive at adjusted figures which will be used in the main body of the report.

UNIT SHIPMENTS

Unit shipments of portable air compressors as reported by the United States Department of Commerce for the years 1967-1972 are as shown in Table I-1.

Table I-1

United States Department of Commerce
Historical Record of Total Unit Shipments
of Portable Air Compressors

<u>Year</u>	<u>Air Flow Capacity Category (cfm)</u>			<u>Total</u>
	<u>75-150</u>	<u>151-400</u>	<u>400 and Over</u>	
1967	6,837	1,887	1,245	9,969
1968	6,130	2,057	1,532	9,719
1969	7,018	3,466	1,793	12,277
1970	5,078	3,397	1,498	9,973
1971	5,319	3,017	1,565	9,901
1972	6,323	3,958	1,873	12,154

Source: United States Department of Commerce, Current
Industrial Reports: Pumps and Compressors.

Table I-2 presents domestic unit shipments of portable air compressors for the years 1967 through 1972 as reported by the Compressed Air and Gas Institute.

Table I-2

Compressed Air and Gas Institute
Historical Record of Domestic Unit
Shipments of Portable Air Compressors

Year	Number of Manufacturers Reporting	Power Source Type and Air Flow Capacity Category (cfm)						
		Gasoline Engine			Diesel Engine			
		75-124	125-250	251-500	501-750	751-1000	1001 and Over	Total
1967	10	1,392	3,723	396	216	780	180	6,687
1968	10	1,752	4,032	616	271	781	271	7,723
1969	11	1,891	4,563	1,015	282	717	292	8,760
1970	10	1,851	3,563	1,046	335	834	318	7,947
1971	11	2,214	3,490	1,444	475	913	334	8,870
1972	11	2,736	4,284	1,865	511	972	420	10,788

Source: Compressed Air and Gas Institute, Complete Portable
Compressor Statistical Summary of Units Shipped and
Total Dollar Value: for Years 1967 through 1972.

The differences between the figures in Tables I-1 and I-2 are as follows:

1. The unit shipments reported by the United States Department of Commerce include exports.
2. The unit shipments reported by the Compressed Air and Gas Institute include domestic shipments only.
3. The shipment data furnished by the Compressed Air and Gas Institute reflect only shipments of those companies reporting to the Institute. Ten companies reported to the Institute in 1967, 1968 and 1970 and eleven in 1969, 1971 and 1972. However, reporting members of the Compressed Air and Gas Institute collectively represent in excess of 90% of the portable air compressor market. The share of nonmembers varies from 1% to 10% depending on the year.

Although total unit shipments reported by the Compressed Air and Gas Institute are consistently lower than those reported by the United States Department of Commerce, little difference exists between the two sources when the preceding factors are considered and adjustments are made for each year. Furthermore, industry experts accept the United States Department of Commerce unit shipment data as being the most accurate data available. Therefore, the Department of Commerce historical record of total unit shipments will be used as the basis for all calculations and projections made in this report.

Using the Department of Commerce figures and making adjustments by power source type and air flow capacity from the Compressed Air and Gas Institute data, the adjusted unit shipments for the years 1967-1972 to be used for purposes of industry analysis are shown in Table I-3.

Table I-3

Unit Shipments of Portable
Air Compressors: 1967-1972

Year	Power Source Type and Air Flow Capacity Category (cfm)						Total
	Gasoline Engine			Diesel Engine			
	75-124	125-250	251-500	501-1000	1001-2000	2001 and Over	
1967	2,075	5,551	590	322	1,163	268	9,969
1968	2,205	5,074	775	341	983	341	9,719
1969	2,650	5,395	1,423	395	1,005	409	12,277
1970	3,323	4,471	1,313	420	1,047	399	9,973
1971	2,471	3,896	1,612	530	1,019	373	9,901
1972	3,082	4,827	2,101	576	1,095	473	12,154

Source: Kearney adjustments based on Tables I-1 and I-2.

DOLLAR VALUE
OF SHIPMENTS

There is a significant variance between the dollar value of portable air compressor shipments reported by the United States Department of Commerce and the value of shipments reported by the Compressed Air and Gas Institute. Table I-4 presents the figures reported by the United States Department of Commerce for the years 1967-1972.

Table I-4

United States Department of Commerce
Historical Record of the Dollar Value
of Portable Air Compressor Shipments(1)

(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity Category (cfm)			Total
	Gasoline Engine, Below 251 cfm (All)	Below 501 cfm	Above 500 cfm	
1967	\$20,440	\$11,897	\$20,598	\$52,935
1968	16,083	11,890	20,817	48,790
1969	18,870	20,609	27,318	66,797
1970	12,296	14,005	21,196	47,497
1971	13,263	12,176	23,996	49,435
1972	15,448	14,842	28,607	58,897

Note: (1) The dollar value of portable air compressor shipments cited excludes the value of the compressor power source (gasoline or diesel engine).

Source: United States Department of Commerce, Current Industrial Reports: Pumps and Compressors.

Table I-5 on the following page presents figures reported by the Compressed Air and Gas Institute for the years 1967-1972.

Table I-5

Compressed Air and Gas Institute
Historical Record of the Dollar Value
of Portable Air Compressor Shipments
(Thousands of Dollars)

Year	Number of Manufacturers Reporting	Power Source Type		Total
		Gasoline	Diesel	
1967	10	\$21,651	\$29,542	\$51,193
1968	10	22,801	33,651	56,452
1969	11	24,495	37,134	61,629
1970	10	19,990	23,162	54,152
1971	11	21,175	43,836	65,011
1972	11	25,890	53,894	79,784

Source: Compressed Air and Gas Institute, Complete Portable Compressor Statistical Summary of Units Shipped and Total Dollar Value: for Years 1967 through 1972.

The differences between the figures reported by the two sources are due to the following:

1. The United States Department of Commerce figures include the value of export shipments.
2. The Compressed Air and Gas Institute figures include only the value of domestic shipments.
3. The United States Department of Commerce dollar value of portable air compressor shipments excludes the value of the compressor power source (the gasoline or diesel engine).
4. The Compressed Air and Gas Institute figures represent total end user sales less 20% (allowance for discounts).

Published discounts of portable air compressors range from 15% to 45% of list price. Discounts generally run 20% to 30% of list price. For the purpose of this survey, it will be assumed

that the average discount is 25% and applies to all shipments, both domestic and foreign.

Current average list prices of portable air compressors by power source type and air flow capacity are as follows:

Table I-6

Portable Air Compressor Average List Prices

<u>Power Source Type and Air Flow Capacity Category (cfm)</u>	<u>Average List Price</u>
75-124 Gasoline	\$ 3,982
125-250 Gasoline	5,741
125-249 Diesel	6,791
250-599 Diesel	17,509
600-899 Diesel	29,376
900 and Over Diesel	48,918

Source: Exhibit III-11.

Average prices of portable air compressors by power source type and air flow capacity for each year can be obtained by applying the wholesale price index for pumps and compressors (average prices for the years 1967-1972 are presented in Exhibit I-1). By applying the following formula, the total dollar value of portable air compressor shipments by domestic manufacturers can be calculated.

Average annual adjusted list price by compressor category	x	Number of compressors shipped per year per compressor category	x	.75 (allowance for a 25% discount off list price)	=	Total annual yearly sales per compressor category
	+	Annual sales in all other categories	=	Total dollar shipments of portable air compressors		

Using this formula, the adjusted annual dollar value of shipments of portable air compressors for the years 1967-1972 is indicated in Table I-7.

Table I-7

Annual Dollar Value of Portable Air
Compressor Shipments: 1967-1974
(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity Category (cfm)						Total
	Gasoline Engine 75-124	Gasoline Engine 125-250	Gasoline Engine 251-500	Diesel Engine 501-1000	Diesel Engine 1001-2000	Diesel Engine 2001 and Over	
1967	\$4,997	\$19,276	\$ 2,424	\$3,410	\$20,664	\$ 7,929	\$58,700
1968	5,555	18,430	3,330	3,777	18,269	10,554	59,915
1969	7,006	24,384	6,418	4,593	19,607	13,287	75,295
1970	6,419	17,869	6,208	5,119	21,411	13,588	70,634
1971	7,237	16,451	8,052	6,955	22,016	13,420	74,131
1972	9,204	20,784	10,701	7,564	24,125	17,354	89,732

Source: Kearney adjustments based on Tables I-4, I-5, I-6 and comments in the text.

These figures appear to be quite comparable with those of the Compressed Air and Gas Institute. For example, the 1972 total of \$89.7 million minus exports of \$19.6 million equals \$70.1 million of domestic shipments. Dividing the \$70.1 million by the factor of .75 (the allowance for dealer discounts) results in a total end user market of \$93.5 million. The value of domestic shipments of compressors reported by the Compressed Air and Gas Institute in 1972 was \$79.8 million. On an adjusted basis, this figure can be translated into an end user market value of \$99.8 million (\$79.8 million divided by .8 factor to adjust for the fact that the Compressed Air and Gas Institute figure represents total end user sales less 20%). The difference between the two end user market calculations of \$99.8 million and \$93.5 million is less than 10%. Furthermore, some industry respondents suggested that the Compressed

Air and Gas Institute figures might be high by as much as 10%. Hence, we believe that the figures in Table I-7 are quite representative of the actual value.

CAPACITY
CONSOLIDATION

The capacity categories used in the Unit Shipment and Dollar Value of Shipment sections are the categories used by Kearney for market analyses. Kearney believes these categories best reflect the competitive product segment grouping of portable air compressors. However, BBN used three categories in their selection of alternative noise levels for study and in the development of technical and cost data. These are gasoline engine, below 251 cfm (all); diesel engine, below 501 cfm; and diesel engine, above 500 cfm) appear incongruent, a discrepancy does not exist because there are no portable air compressors manufactured in the air flow capacity of 451-599 cfm.

Unit shipments of portable air compressors consolidated into the BBN categories are shown in Table I-8 on the following page.

Table I-8

Unit Shipments of Portable
Air Compressors: 1967-1972

Year	Power Source Type and Air Flow Capacity Category (cfm)			Total
	Gasoline Engine, Below 251 cfm (All)	Diesel Engine		
		Below 501 cfm	Above 500 cfm	
1967	7,626	912	1,431	9,969
1968	7,279	1,116	1,324	9,719
1969	9,045	1,818	1,414	12,277
1970	6,794	1,733	1,446	9,973
1971	6,367	2,142	1,392	9,901
1972	7,909	2,677	1,568	12,154

Source: Table I-3.

Current average list prices of portable air compressors by BBN power source type and capacity category are shown in Table I-9.

Table I-9

Portable Air Compressor Average List Prices

<u>Power Source Type and Air Flow Capacity Category (cfm)</u>	<u>Average List Price</u>
Gasoline, Below 251 cfm (All)	\$ 5,055
Diesel, Below 501 cfm	9,036
Diesel, Above 500 cfm	35,277

Source: Exhibit III-12.

The adjusted annual dollar value of shipments of portable air compressors consolidated into the BBN categories for the years 1967-1972 is indicated in Table I-10 on the following page.

Table I-10

Annual Dollar Value of Portable Air
Compressor Shipments: 1967-1972
(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity Category (cfm)			Total
	Gasoline Engine Below 251 cfm (All)	Diesel Engine		
		Below 501 cfm	Above 500 cfm	
1967	\$24,273	\$ 5,834	\$28,593	\$58,700
1968	23,985	7,107	28,823	59,915
1969	31,390	11,011	32,894	75,295
1970	24,308	11,327	34,999	70,634
1971	23,688	15,007	35,436	74,131
1972	29,988	18,265	41,479	89,732

Source Table I-7.

THE ENVIRONMENTAL PROTECTION AGENCY

PORTABLE AIR COMPRESSOR AVERAGE
LIST PRICES: 1967-1972
(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity Category (cfm)				
	Gasoline Engine 75-124	125-250	125-249	Diesel Engine 250-599	600-899 900 and Over
1967	\$3,211	\$3,630	\$5,477	\$14,120	\$23,690
1968	3,359	4,843	5,729	14,770	24,780
1969	3,525	5,084	6,014	15,504	26,012
1970	3,696	5,329	6,304	16,252	27,267
1971	3,905	5,630	6,660	17,170	28,807
1972	3,982	5,741	6,791	17,509	29,376
					\$39,450
					41,265
					43,316
					45,407
					47,971
					48,918

Sources: Exhibit II-11.
United States Department of Commerce, U.S. Industrial
Outlook 1974, with projections to 1980, Pumps and Compressors.

EXHIBIT I-1

APPENDIX J
FOREIGN TRADE

EXPORTS

Exports to the great majority of foreign nations consist chiefly of the larger, more sophisticated portable air compressors which are not manufactured in many foreign countries. In addition, significant exports are made to Canada and Mexico. The power source and air flow capacity distribution of these units is about the same as units sold in the United States. Domestic firms offering early deliveries and reliable service are the most successful exporters.

Exports of portable air compressors have accounted for 6% to 13% of total shipments, depending on market conditions. Table J-1 indicates the unit and dollar volume of portable air compressor export shipments over the period 1969-1972.

Table J-1

Portable Air Compressor Exports, 1969-1972
(75 cfm and Above)

<u>Year</u>	<u>Units</u>	<u>Percent of Total Shipments</u>	<u>Value (\$000)</u>	<u>Percent of Total Shipments</u>
1969	1,566	12.8%	\$17,900	23.8%
1970	667	6.7	8,000	11.3
1971	797	8.1	10,100	13.6
1972	1,355	11.1	17,500	19.5

Sources: United States Department of Commerce, Current Industrial Reports: Pumps and Compressors; and Kearney estimates.

From the data in the preceding table note that:

1. Annual dollar value of exports of portable air compressors ranged from a low of \$8.0 million to a high of \$17.9 million.
2. Unit exports ranged from 667 to 1,566.
3. Exports represented a greater portion of total shipments in those years where larger total export shipments occurred.
4. Exports appear to be cyclical.

Exports as a percent of total unit shipments ranged from 6.7% to 12.8%. Exports as a percent of the total dollar value of shipments ranged from 11.3% to 23.8%. This indicates that a greater percentage of the larger capacity units are exported than are sold domestically, as shown in Table J-2.

Table J-2

Estimated Distribution of Export
Shipments by Power Source Type and Air Flow
Capacity, 1972

<u>Power Source Type and Air Flow Capacity Category</u>	<u>Percent of Total Export Shipments</u>
Gasoline, Below 251 cfm (All)	37.3%
Diesel, Below 501 cfm	25.8
Diesel, Above 500 cfm	36.9

Sources: Field survey interviews; manufacturer responses; and Kearney estimates.

Industry respondents indicate that the above relationship is fairly typical of historical experience and such relationships can be expected to prevail in the future. On this basis, Table

J-3 reflects the probable mix of shipments by power source type and air flow capacity from 1969 to 1972.

Table J-3

Export Unit Shipments by Power
Source Type and Air Flow Capacity

<u>Year</u>	<u>Gasoline Engine Below 251 cfm (All)</u>	<u>Diesel Engine</u>		<u>Total</u>
		<u>Below 501 cfm</u>	<u>Above 500 cfm</u>	
1969	584	404	578	1,566
1970	249	172	246	667
1971	297	206	294	797
1972	505	350	500	1,355

Source: Kearney estimates based on Tables J-1 and J-2.

Kearney survey interviews indicate that exports will remain fairly constant through 1978. Exports to the great majority of foreign nations will continue to consist of the larger, more sophisticated portable air compressors. Exports to Canada and Mexico will continue to consist of the same product mix as that sold in the United States.

Industry respondents indicate that if noise emission standards are set in the United States, exports will not be significantly affected. Each individual country has its own requirements in relation to noise, and present shipments must meet these standards. Furthermore, the Noise Control Act of 1972 does not establish noise regulations for exports.

IMPORTS

Imports will be discussed in terms of (a) the current situation in the United States, (b) the projected situation through 1978 and (c) changes that could occur if noise regulations are

established. Seventeen portable air compressor manufacturers and 28 distributors responded to the import discussion.

(a) Current Import Situation

Presently, imports are not a significant factor in the portable air compressor market. Imports represented less than 7% of industry unit volume in 1972. This included Sullair and American Jenbach, which import components and assemble the finished product in the United States. Excluding Sullair and American Jenbach, 1972 imports represented less than 4% of industry unit volume.

A complete list of portable air compressor imports is not available. However, the dominant companies which imported into the United States market over the past five-year period were the following:

American Jenbach	Austria
Atlas Copco	Sweden
Benard	France
Bristol	Great Britain
Broomwade	Great Britain
Burlington	Great Britain
Flottman	Germany
Holman	Great Britain
Ingersoll-Rand	Great Britain
Maco-Meudon	France
Master	Japan
Maxim	Great Britain
Kobe Steel	Japan
Pokorney	Germany
Sullair	Finland
Trans Union (Petter)	Great Britain
Unit Air	Germany
Veico (Subsidiary of Bauer)	Germany

Of these, only American Jenbach, Atlas Copco and Sullair

are considered by domestic portable air compressor manufacturers as serious competition.

Kearney's survey of distributors revealed that generally there is little competition from imports. Distributors in the South, Midwest, Central and Southwest areas of the United States stated that they had little or no competition from imports. Distributors in the Northeast stated that they had only slight competition from imports. Distributors in the Central Atlantic and West said that competition from imports is moderate.

Imported portable air compressor prices are generally competitive or lower than domestic manufacturers' prices.

Excluding Atlas Copco, Sullair and American Jenbach, imports have not significantly penetrated the United States portable air compressor market, primarily because foreign manufacturers have not successfully established distribution networks. Their difficulty in establishing distribution is due to the following factors:

1. A reputation for poor product quality.
2. Poor service and parts delivery.
3. Intense competition by domestic portable and compressor manufacturers.

(b) The Projected Import
Situation through 1978
under Current Conditions

If no noise regulations are adopted, imports are expected to remain constant at approximately 5% to 10% of total unit

shipments. This will be primarily due to lack of effective distribution networks.

(c) Changes Likely If
Noise Regulations
Are Established

Some foreign manufacturers are ahead of domestic manufacturers in quieting technology and production of quieted units. Atlas Copco and Sullair both offer units which currently meet Level One and approach Level Two. BBN is in the process of investigating certain French and German portable air compressor manufacturers which are rumored to have production models that meet or approach Level Two requirements.

If noise regulations are established and domestic manufacturers have to raise the price of their units to meet these regulations, imports might gain a much larger market share. A lower import price and a temporary shortage of domestic quieted units (manufacturers might not be able to build production quieted units within the allotted time period) could make some distributors turn to imports as a source of supply. This would give them a good chance to establish an effective distribution system in the United States. If a good distribution system were established, imports could seize and permanently hold a sizeable market share.

APPENDIX K

TRENDS IN PORTABLE AIR COMPRESSOR SHIPMENTS BY
POWER SOURCE TYPE AND AIR FLOW CAPACITY

Changes in market share reflect portable air compressor economic and application advantages. Some definite trends have occurred in portable air compressor purchases during the 1967-1972 period.

UNIT SHIPMENT
TRENDS

Table K-1

Percent of Total Unit Shipments of
Portable Air Compressors by Power Source Type
and Air Flow Capacity Category: 1967-1972

Year	Power Source Type and Air Flow Capacity Category (cfm)						Total
	Gasoline Engine		Diesel Engine				
	75-124	125-250	125-249	250-599	600-899	900 and Over	
1967	20.8%	55.7%	5.9%	3.2%	11.7%	2.7%	100%
1968	22.7	52.2	8.0	3.5	10.1	3.5	100
1969	21.6	52.1	11.6	3.2	8.2	3.3	100
1970	23.3	44.8	13.2	4.2	10.5	4.0	100
1971	24.9	39.3	16.3	5.4	10.3	3.8	100
1972	25.4	39.7	17.3	4.7	9.0	3.9	100

Source: Table I-3.

The table indicates that:

1. The market share of the diesel engine, 250-599 cfm, 600-899 cfm, and 900 cfm and over portable air compressor air flow capacity categories remained fairly constant over the 1967-1972 period.

2. The market share of the gasoline engine, 75-124 cfm category increased from 20.8% to 25.4% during the 1967-1972 period.

3. The market share of the diesel engine, 125-249 cfm category increased from 5.9% to 17.3% during the 1967-1972 period.

4. The market share of the gasoline engine, 125-250 cfm category decreased from 55.7% to 39.7% during the 1967-1972 period.

The percent market share of the diesel engine, 250 cfm and over categories are essentially constant over this period. It can therefore be concluded that the 16% decrease in the market share of units in the gasoline engine, 125-250 cfm category is attributable to an approximate 5% increase in the gasoline engine, 75-124 cfm category and an approximate 11% increase in the diesel engine, 125-249 cfm category.

REASONS FOR MARKET SHARE TRENDS

The most important reasons for these market share trends are the following:

1. Diesel engine portable air compressors cost less in most instances when initial, operational and maintenance costs are considered over the expected life of the compressor (assuming the portable air compressors have identical air flow capacity capabilities).

- (a) Initial Costs. Generally, in the air flow capacity ranges where diesel and gasoline engine portable air compressors compete, a \$1,000 premium is paid for the diesel.
- (b) Operational Costs. Diesel engine portable air compressors are much cheaper to run. An order-of-magnitude estimate of the revolutions per minute (or mileage) of a diesel engine versus a gasoline engine compressor is approximately five to three, respectively. Over the 1967-1972 period, diesel fuel generally sold at approximately 4¢ per gallon less than gasoline. This 4¢ per gallon differential in fuel cost is still valid in today's market and is expected to continue through 1978. On this basis, the relative operating costs of a diesel engine portable air compressor are on the order of 40% to 60% of the gasoline engine compressor operating costs.
- (c) Maintenance Costs. Diesel engines cost less to maintain. Portable air compressor use characteristics are such that the engine intermittently operates at full load and then idles for relatively long periods of time. Diesel engines are most suitable for these operating conditions because this operating pattern does not cause additional maintenance. However, this use pattern causes frequent maintenance on gasoline engine compressors due to the effect long idle periods have on the ignition system. Engine manufacturers estimate that diesel engines used in portable air compressors average 8,000-10,000 hours use

before a major overhaul while gasoline engines average 2,000-3,000 hours use.

On the basis of the above cost factors, an accepted rule of thumb in the construction industry is that if a contractor purchases a diesel engine portable air compressor and uses it 3,000 to 4,000 hours per year, he will recover the difference in cost (between a diesel engine compressor and a gasoline engine compressor with identical air flow capacity capabilities) in three to four years.

2. Diesel engine portable air compressors are generally more reliable than those with gasoline engines. Contractors state that fewer on-the-job breakdowns are experienced with diesel engine compressors.

3. Diesel engine manufacturers made a concentrated effort to enter and penetrate the small engine market during the 1967-1972 period. Diesel engines were heavily promoted and deliveries were good during this period.

4. The air requirements of some customers shifted downward and enabled them to purchase smaller capacity gasoline engine portable air compressors.

CONCLUSIONS

The diesel/gas split is sensitive to the absolute price differences in the air flow capacities where both units compete. For operators with over 3,000 to 4,000 hours use per year, the economic advantages of diesel are greater than the current price differential. If application of quieting technology raises the

price differential between diesel and gas units, it is possible that a significant change in product mix could occur. Kearney estimates that a price differential of \$3,000 to \$4,000 would eliminate the economic advantages of diesels in many applications.

APPENDIX LCALCULATION OF LEVEL TWO
TRANSPORTATION COST INCREASES

Level Two transportation cost increases can be calculated on the basis of additional dollars per cfm. Under current technology, the modifications necessary to meet Level Two noise emission standards will result in a larger, heavier compressor. This larger, heavier compressor must be transported to the distributor and/or end user and to the job site. Increasing size and weight will result in the shipment of fewer portable air compressor units per truck trailer or railroad car and increased weight. Table L-1 shows the average increase in transportation cost per unit shipped based on the most popular unit in each air flow capacity category and an average compressor shipment distance.

Table L-1

Transportation Cost Increase per Unit
Resulting from the Adoption
of the Level Two Standard(1)

<u>Power Source Type</u>	<u>Air Flow Capacity (cfm)</u>	<u>Transportation Cost Increase per cfm</u>	<u>Transportation Cost Increase per Unit</u>
Gasoline Engine	75-124	\$.23	\$20.70
Gasoline Engine	125-250	-0-	-0-
Diesel Engine	125-249	-0-	-0-
Diesel Engine	250-599	.27	89.10
Diesel Engine	600-899	.12	81.00
Diesel Engine	900 and Over	.03	33.06

Note: (1) A detailed explanation of the calculations and logic used to derive the dollar amount of price increase per average unit in each category is presented in Exhibit L-1.

Source: Exhibit L-1.

The increase in annual transportation expenditures incurred by end user industries from manufacturers' plants to distributor and/or end user locations is derived by multiplying the projected 1977 demand (in units) at Level Two by the projected increase in transportation costs per unit (Exhibit V-9 and Table L-1, respectively). These transportation cost increases specifically exclude price increases due to inflation or higher costs due to increases in the cost of transportation, material, labor and overhead. Table L-2 below reflects the total increase in transportation expenditures in 1977 from manufacturers' plants to distributor and/or end user locations for portable air compressors by power source type and air flow capacity.

Table L-2

Level Two Estimated 1977 Domestic
Transportation Expenditure Increase(1)

<u>Power Source Type</u>	<u>Air Flow Capacity Category (cfm)</u>	<u>Increased Transportation Expenditures (\$000's)</u>
Gasoline Engine	75-124	\$ 45
Gasoline Engine	125-250	-0-
Diesel Engine	125-249	-0-
Diesel Engine	250-599	27
Diesel Engine	600-899	121
Diesel Engine	900 and Over	18
Total		<u>\$211</u>

Note: (1) A detailed description of the calculation of these increased transportation expenditures is presented in Exhibits L-1, L-2 and L-3.

Source: Kearney estimates.

The table indicates that:

1. The increased transportation costs associated with Level Two are relatively insignificant, amounting to only \$211,000.
2. The largest dollar increase in transportation costs is in the 600-899 cfm category of diesel driven compressors.
3. There is no increase in transportation costs in the 125-250 cfm gasoline and diesel categories.

Some increases in end user transportation costs will be associated with transporting portable air compressors to and from the job site. However, the general impact will be insignificant. Most large contractors own their own trucks and will be able to arrange equipment shipments in such a way that their costs will not rise. Smaller contractors typically own no more than one portable air compressor, and a larger, heavier compressor will in all probability result in no increased transportation costs, since the same truckload minimums are involved.

THE ENVIRONMENTAL PROTECTION AGENCY

CALCULATION OF INCREASED TRANSPORTATION
COSTS ASSOCIATED WITH LEVEL TWO(1)
(Thousands of Dollars)

Year	Power Source Type and Air Flow Capacity (cfm)									Grand Total
	Gasoline Engine			Diesel Engine						
	75-124	125-250	Total	125-249	250-599	Total	600-899	900 and Over	Total	
1976	\$44	\$-0-	\$44	\$-0-	\$26	\$26	\$118	\$17	\$135	\$205
1977	45	-0-	45	-0-	27	27	121	18	139	211
1978	47	-0-	47	-0-	29	29	124	19	143	219

Note: (1) Transportation costs are calculated by multiplying the adjusted Level Two volume (as derived from Exhibit L-2) by the transportation cost increase per unit (as derived from Exhibit L-3).

THE ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF BBN PORTABLE AIR COMPRESSOR PRODUCT GROUPINGS
INTO KEARNEY PRODUCT GROUPINGS AFTER THE LEVEL TWO VOLUME IMPACT(1)

Year	Power Source Type and Air Flow Capacity (cfm)								Grand Total	
	Gasoline Engine			Diesel Engine						
	75-124	125-250	Total	125-249	250-599	Total	600-899	900 and Over		Total
1976	2,127	3,024	5,151	1,295	296	1,591	1,452	524	1,976	
1977	2,190	3,025	5,215	1,348	308	1,656	1,491	549	2,040	
1978	2,255	3,025	5,280	1,403	323	1,726	1,532	564	2,096	

THE ENVIRONMENTAL PROTECTION AGENCY

CALCULATION OF INCREASED TRANSPORTATION
COSTS ASSOCIATED WITH LEVEL TWO QUIETING

Air Flow Capacity Category	Standard and Level One Units				Level Two Units				
	Typical Unit (1)	Rate (2)	Truckload Shipment (3)	Rate per Unit (4)	Rate per cfm (5)	Rate per Unit (4)	Truckload Shipment (3)	Rate per cfm (5)	Rate Increase per Unit (7)
75-124	90	\$600	6	\$100	\$1.18	\$600	5	\$120	\$20.70
125-249	158	600	5	120	.75	600	5	120	-0-
250-599	330	600	3	200	.55	600	2	300	.27
600-899	675	660	3	220	.29	620	2	310	.41
900 and Over	1,102	660	2	330	.25	680	2	340	.03

Notes: (1) A typical unit is presented in terms of air flow capacity and is the average capacity for each air flow capacity category as derived in Exhibit III-9. The air flow capacities submitted by the manufacturer corresponded to the most popular unit in each category. They were 85 cfm, 160 cfm, 365 cfm, 750 cfm and 1,200 cfm. There are no significant differences between the size and weight requirements of these units and those listed in the typical unit column.

(2) Rate is the minimum truckload freight rate based on the average distance from manufacturers' plants to customer locations.

(3) Truckload shipment is the number of units which can be shipped per truckload.

(4) The rate per unit is the minimum truckload freight rate divided by the number of units which can be shipped per truckload.

(5) The rate per cfm is the dollar transportation cost per cfm. This is calculated by dividing the rate per unit by the cfm designation of the typical unit in each air flow capacity category.

(6) The rate increase per cfm is the average increase in transportation cost per cfm based on the typical unit in each air flow capacity category.

(7) The rate increase per unit is the average increase in transportation cost per unit shipped based on the typical unit in each air flow capacity category.

Source: A major portable air compressor manufacturer.

APPENDIX MTHE INFLUENCE OF QUIETING ON OPERATING COSTS

BBN made a study of the effect of quieting on operating costs. They concluded that quieting by present technology imposes the penalty of increased operating costs. The reasons for this were the following: (a) a larger, heavier compressor must be towed to the job, (b) more fuel is consumed to generate the horsepower necessary to drive an inefficient fan system, and (c) maximum ratings must be adjusted to account for the heat rise in inefficient enclosures. Kearney has reviewed each of the above operating cost penalty areas with manufacturers to determine the extent of the penalty which may arise. The following paragraphs briefly summarize the results of the review.

The noise attenuating enclosure required for quieting results in a larger, heavier compressor which must be moved to the job site. The two-wheel compressor is usually towed to the job site. The cost of towing extra weight behind a vehicle already moving to the job site was considered negligible by all manufacturers contacted. (The cost of transportation by a machinery hauler is discussed in detail in Appendix L). Generally, the four-wheel portable air compressors are moved to and from the job site on a lowboy trailer. Current loads are well below minimum size and weight restrictions. The type of contractor which has a requirement for a large, four-wheel compressor generally owns the lowboy. Therefore, in the majority of cases additional size and weight do not result in any increase in operating costs. In summary,

the cost of transportation is basically insensitive to the size and weight increases which are imposed by the application of noise abating technology.

The modifications required on the fan system to achieve quieting create the need for more horsepower because of the inefficient fan system. This may involve a fuel penalty. Manufacturers point out that typically the portable air compressor use pattern is such that owners are somewhat insensitive to minor fluctuations in fuel costs. For example, typically compressors are operated on a full shift basis. Contractors generally let compressors idle when not in use because the cost of employing operators to turn the machine on and off is greater than the fuel savings. The fuel penalties associated with noise attenuation appear to be less than 5%. This is expected to have a negligible impact on operating practices with respect to conservation of fuel based on current labor/fuel trade-offs.

Manufacturers agree that, theoretically, maximum horsepower ratings must be adjusted to account for the heat rise in inefficient enclosures. However, most manufacturers believe that they have provided enough horsepower margin in their specifications to allow them to continue to utilize the same engines in their quieted models. Thus, adjustment of horsepower ratings does not appear to be an additional cost which should be included in the cost of quieting the unit.

In summary, while there may be some changes in operating costs due to the application of quieting technology, their impact is expected to be insignificant in terms of increased operating costs and operating practices.